*The*

# Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. IX, No. 4 April, 1918

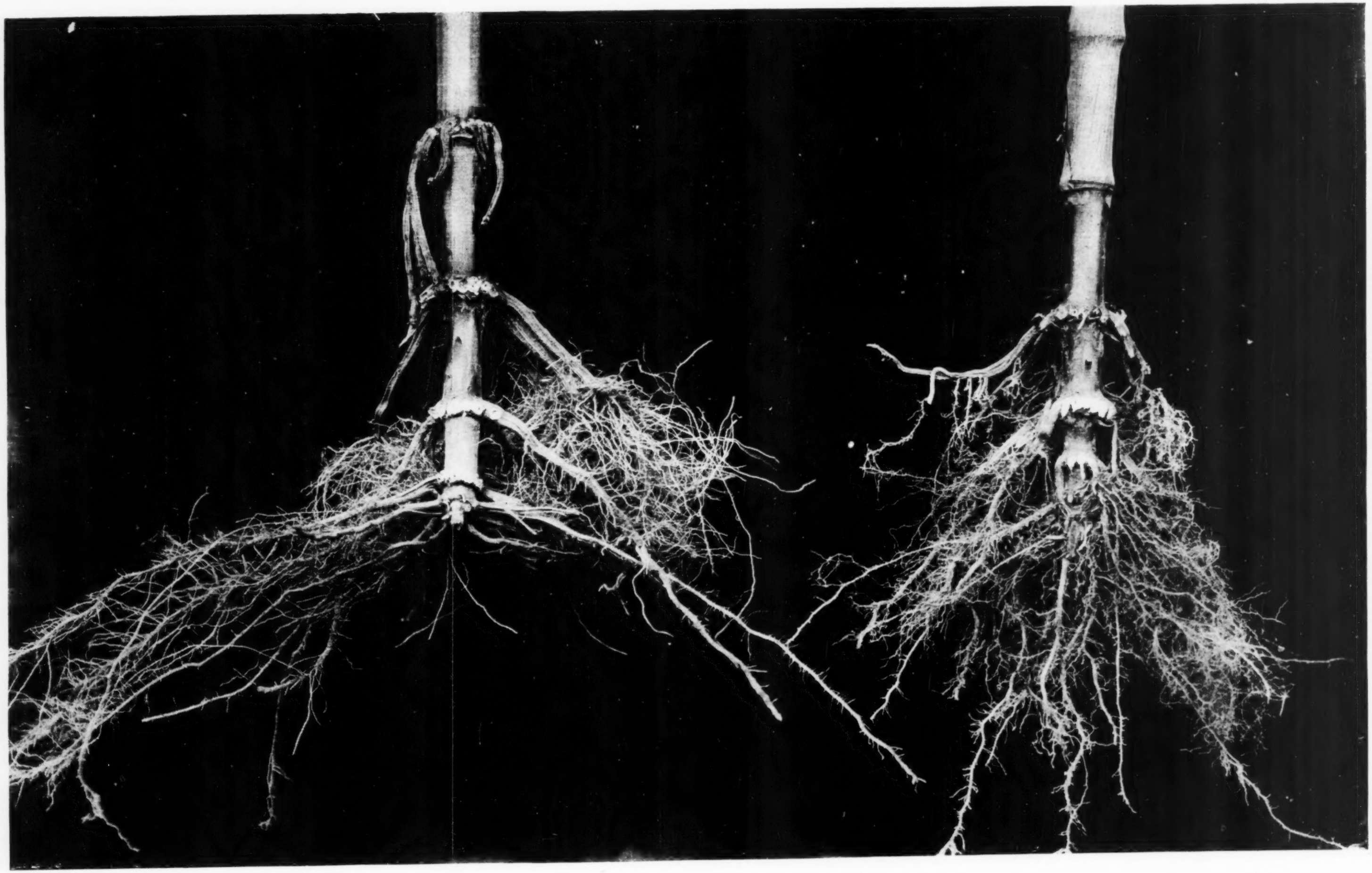
## CONTENTS

Tropical Varieties of Maize, by G. N. Collins ..... 147
Improper Feeding among New York School Children ..... 154
Advertising New Plant Foods, by David Fairchild ..... 155
Ohio Germination Tests Reveal Lack of Good Seed Corn ..... 157
Another Chance for the Filbert ..... 158
Improvement of Beans in Manchuria ..... 160
Lethal Factors and Sterility, by John Belling ..... 161
Improvement of Labor Conditions for Women in France ..... 165
An Anomaly of Wheat Anthers, by S. A. Anthony ..... 166
Reciprocal Breeding in Tomatoes, by Byron D. Halsted ..... 169
Proposed South African Agricultural Census ..... 173
A Dry Blood-orange Strain, by A. D. Shamel ..... 174
A New Eugenics Organization Founded in Brazil ..... 177
Pigmentation in Guinea-pig Hair, by Harrison R. Hunt and Sewall Wright 178
Budding Incompatible Cottons ..... 181
Some Observations on Monkeys, by R. W. Shufeldt ..... 182
Penetration of Scion by Stock, by G. B. Patvardhan ..... 187
Striking Orange Bud Variations, by A. D. Shamel ..... 189
Nature as a Nature Faker, by E. P. Humbert ..... 192

The Journal of Heredity is published monthly by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

Entered as second-class matter February 24, 1915, at the postoffice at Washington, D. C., under the act of August 24, 1912. Contents copyrighted 1918 by the American Genetic Association. Reproduction of articles or parts of articles permitted provided proper credit is given to author and to the Journal of Heredity (Organ of the American Genetic Association), Washington, D. C.

Date of issue of this number, MARCH 30, 1918.



**COMPARATIVE ROOT DISTRIBUTION OF MAIZE**

Root distribution of *Zea hirta* to the left, and of an ordinary dent variety on the right. The surface distribution of the roots of *Zea hirta* enables this type of maize to utilize the water from light showers and even dew. On the other hand, the failure of its roots to penetrate the soil precludes utilization of stored moisture. (Frontispiece.)

# TROPICAL VARIETIES OF MAIZE

## Great Diversity of Types of Maize—Most Important Food Crop Cultivated by Natives of America at Time of Discovery—Plant Shows Wide Distribution[1]

G. N. COLLINS

*Bureau of Plant Industry, U. S. Department of Agriculture*

MAIZE, or Indian Corn, was the most widely distributed and by far the most important food plant cultivated by the natives of America at the time of the discovery. It is still the most important American crop plant, and while much more productive strains have been developed than any grown by the aborigines, the range of the species on the American Continent has not been greatly extended.

To be able to grow under the widely different conditions that are found in the region from central New England to Argentina and Chile, there must be a great diversity of types. How great this diversity is and how inadequately it has been utilized in developing strains adapted to the needs of the different agricultural communities it is the object of the present paper to discuss.

The Department of Agriculture here at Washington has for a number of years been collecting the types of maize from the different parts of the world. These varieties have been grown and their characteristics studied with a view to determining which of the characters they possess may be utilized in developing varieties better adapted to the different parts of the country.

It has not been possible to make an adequate survey of the existing varieties of any country and there are many regions of which we have practically no knowledge of the kinds of maize. Agricultural expeditions that are sent out are usually compelled to pass more or less hurriedly through the countries they visit and the explorers in charge are always charged with collecting a great variety of plants and data, so that little more can be done than to snatch what is exhibited in the markets or what is found growing immediately along their routes. Such collections have been supplemented by seed secured from consuls and correspondents. While many valuable introductions have been secured in this way, ignorance of the normal behavior of the varieties and of the cultural and climatic conditions under which they have been grown often stand in the way of making the most of the peculiar qualities they may possess.

As a result of this rather haphazard manner of securing material our collections are very uneven. In some few places the series of varieties is comparatively complete, but there are whole countries not represented in our collection by a single maize variety. Enough has come to light, however, to show that, especially in the countries of tropical America, we have an immense storehouse of valuable material that awaits the utilization of the breeder.

We have come to believe that the search must be made for characteristics rather than for varieties ready made, as it were. It seldom happens that a variety from one locality will be found adapted to any other locality, but often the most unpromising and insignificant variety, grown perhaps by some backward tribe of natives, will possess some peculiarity or adaptation that needs only to be combined with the desirable qualities of other varieties to become of great value.

Instead, therefore, of attempting to present any complete description of

---

[1] Paper presented before the Second Pan-American Scientific Congress, Washington, D. C., December 27, 1915–January 8, 1916.



Root distribution of *Zea mays* to the left, the latter type of maize to utilize the water from light showers and even dew. On the other hand, the tall enables this type of maize to utilize the water from light showers and even dew. (From frontispiece.)
trate the soil precludes utilization of stored moisture.

varieties of corn, I shall enumerate a few of the more striking adaptations that have thus far been discovered, beginning with the varieties grown by the Indians of the western United States.

### HOPI MAIZE

The Hopi, Navajo, and Zuñi Indians are still growing a type of maize that seems to have spread but little outside the region inhabited by these tribes. The prevailing type of seed is soft or amylaceous, the plants tiller abundantly, they are early maturing, and make comparatively rapid growth at low temperatures. Their exact water requirement has not been determined, but it would appear that they are comparatively economical in the use of water. These characters, while valuable, are all quantitative. This type of maize does, however, possess one unique feature. All other types of maize thus far studied produce three or more roots from the seed. These roots support the young plant until the permanent roots that develop from the nodes have been formed. In the type under discussion there is but one root developed from the seed. The economy of this arrangement seems to be that the single root is able to penetrate to a greater depth than is possible when the reserve material of the seed is divided among three or more roots.

In combination with this character there is also the possibility of a much greater development of the mesocotyl than in other types. The mesocotyl is a specialized organ found in the seedlings of maize and some other grasses. It may be described as the part of the main axis that connects the seed with the first leaf of the seedling. So long as the germinating seed remains in the dark, the mesocotyl elongates, stopping only when the tip of the seedling reaches the surface of the ground or the limit of elongation is reached. In planting their maize the Hopi Indians dig into the sandy soil until they reach moist earth, usually found at a depth of from 6 to 18 inches. The seed is deposited in these holes in contact with the moist soil. Although these holes may be left only partly filled, the drifting sand soon fills them, and to reach the surface the young plants must penetrate from 6 inches to a foot of soil.

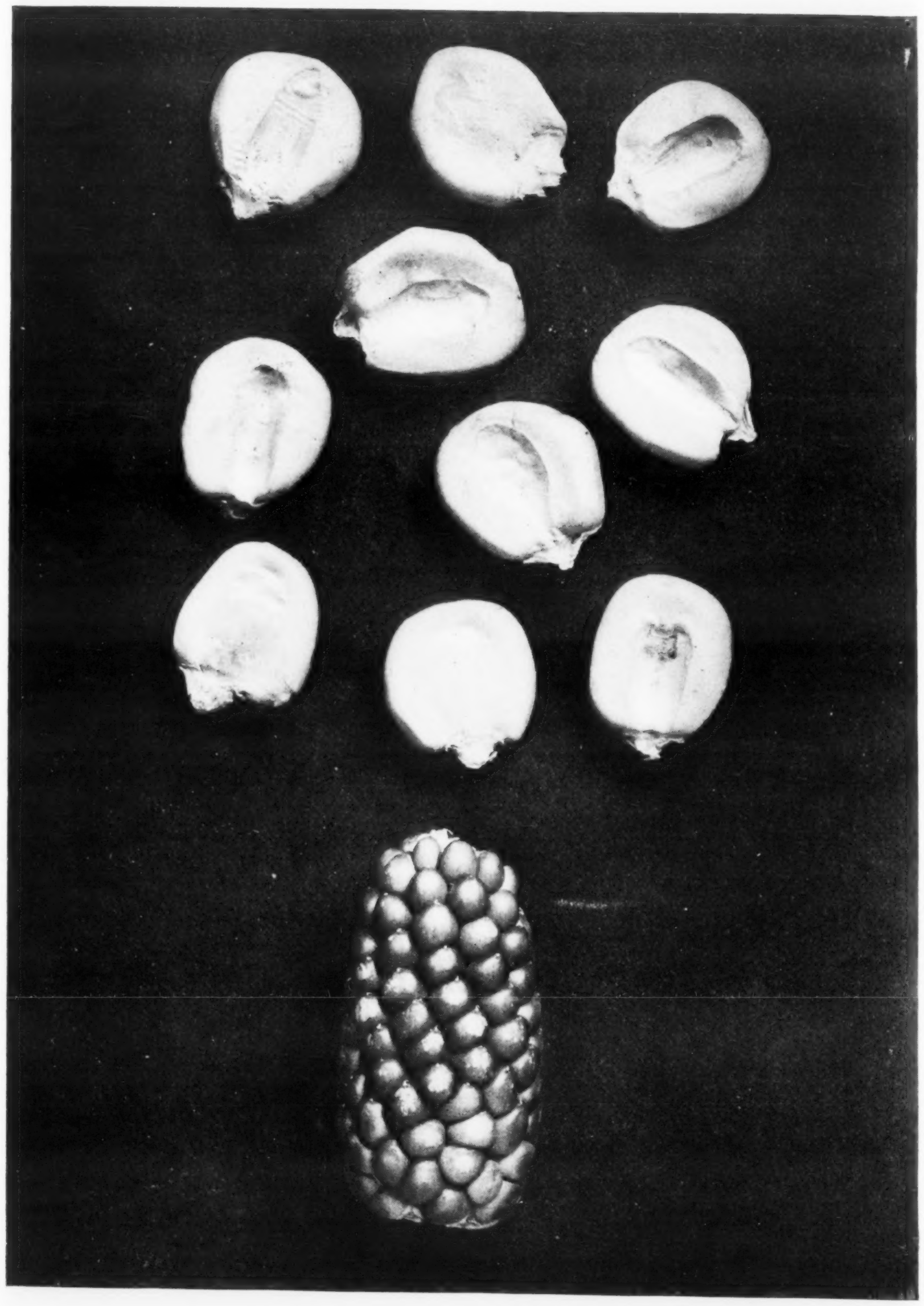
Experiments have shown that commercial varieties of maize planted under these conditions will not reach the surface. The maximum development of the mesocotyl in commercial varieties is from 8 to 10 centimeters. After this elongation is reached the leaves attempt to expand beneath the ground, and as they unfold they are not sufficiently rigid to force their way through the soil.

It was found that the mesocotyl of Hopi maize is capable of elongating to a length of 36 centimeters or over three times the length attainable in other varieties. At the same time the single strong seminal root is following the retreating moisture and keeping the young plants alive until the summer rains wet the soil above and allow the development of lateral roots. A long mesocotyl thus divides the work of reaching moisture with the single seminal root and the combination makes possible the establishing of young plants in soils where the nearest available moisture is a foot or more below the surface of the ground.

These peculiarities make this type of maize beautifully adapted to the conditions that obtain on the wind-swept plateaus of northern New Mexico and Arizona where the variety is grown. In this region there is a winter rainfall, but by the time the weather is sufficiently warm to warrant the planting of maize, the surface soil is thoroughly dry. Summer rains may be expected in June or July, but if planting were delayed until the rains came there would not be time enough for the crop to mature before the frosts came in September.

These adaptations should find an application wherever maize is planted during a dry season, and the young plants are forced to depend on moisture stored in soil. At San Diego, Cal., the past season plants of this type matured normally without a drop of rain during the growing season.

That adaptations of so great economic importance should exist inside our own country and remain unnoticed is a striking indication of how inadequately the possibilities of maize development have been investigated.



**MAIZE FROM PERU AND BOLIVIA**

Seeds of Cuzco maize from Peru and an ear of a Bolivian variety of maize having the quality of remaining green a long time after maturity. Photograph natural size. (Fig. 1.)

Another set of interesting adaptations have been found in a type of maize from the table-lands of Mexico. This type was early recognized as a distinct form. In 1829 it was given specific rank by Bonafous under the name *Zea hirta*.

The most striking characteristic of this type is a peculiar development of hairs on the leaf sheaths and also to some extent on the blades. For this most conspicuous peculiarity we have not as yet been able to discover any adaptive significance.

On the tablelands of Mexico where this maize is grown the rainfall is very light. In the parts of the United States with a similar rainfall maize productiont is not considered possible. We were, therefore, extremely optimistic regarding the utilization of this type of maize. Our early experiments were very disappointing. In the semiarid regions of the West this variety was a complete failure. Instead of being drought resistant the plants appeared to suffer from drought more than the ordinary varieties from the corn belt. Without the viewpoint that each distinct type of maize possesses adaptive characters this variety would have been discarded as worthless. As soon, however, as the variety was scrutinized with respect to the separate characteristics instead of trying to utilize it as it was, important adaptations came to light. The first peculiarity noticed was the nature of the root distribution. In this type of maize the roots seem to have lost the ability to penetrate the soil. In a full grown plant the roots are all horizontal and confined to the upper 6 inches of soil. There is so little direct attachment to the soil that the whole plant can be lifted up and down by the hand. The plants are on rather than in the ground. This peculiar root distribution helps to explain why the plants are able to grow in Mexico with so little rainfall and why they fail in the western part of our country. In the part of Mexico from which this variety was secured the little rain that falls comes during the growing season in the form of light, misty showers. The rainfall is at no time sufficient to penetrate to any extent and an extensive superficial root system is best adapted to utilize the moisture.

This particular adaptation we are unable to utilize in this country, for in the drier parts of the United States the rainfall comes largely in the winter instead of during the growing season, and growing plants must draw their water from that stored in the ground some distance below the surface. There are, however, many regions in tropical America where this adaptation should be of value. Through the work of Briggs and Shantz, of the Department of Agriculture, it has been shown also that *Zea hirta* is the most economical of water of any of the varieties of maize yet studied.

_Still another adaptation possessed by this type of maize was observed during the past season in the course of experiments conducted near San Diego, Cal. It there developed that this type of maize made satisfactory growth at lower temperatures than any of the other types with which we were experimenting. This does not mean frost resistance, nor does it mean that this type is suited to extend maize growing farther north. It means rather that this type possesses one of the characteristics necessary to a variety of maize for regions where the temperatures are uniformly too low for the ordinary varieties. Temperatures below the optimum for maize are the rule over a large part of the elevated regions of the tropics. In the development of varieties for cool climates, this type of maize promises to be of great value. Our experience with *Zea hirta* shows also the folly of looking for drought resistance as such. To make progress, we must distinguish between the different kinds of drought resistance and search for the particular adaptation needed.

Nearly every region from which we have received varieties has contributed adaptations that promise to be of value. From Bolivia has come a type possessing to a marked degree the quality of remaining green for a long time after maturity. Mexico has given us one variety with the largest ears and another with the ability to withstand extremely

**WAXY CHINESE MAIZE**

A typical plant of the Waxy Chinese variety of maize, showing numerous tassel branches, erect leaf blades and curved tassel. The kernels of this remarkable Chinese maize have a waxy endosperm which distinguishes them in a striking way from other varieties of maize. Photograph by courtesy of the *Journal of Agricultural Research*. (Fig. 2.)

high temperatures. Peru contributes the largest seeds. From China comes a variety with a new type of endosperm and the ability to withstand hot dry winds at the time of flowering. Our best protected ears come from Guatemala.

Enough has now been said to indicate what is meant by adaptation and how the varieties must be studied to realize and appreciate the adaptations. Only a beginning has been made. When it is realized that no two regions present exactly the same environment and that maize, though a very ancient crop, is very plastic and has molded itself to the conditions under which it has been grown, some idea may be gained of the multitude of adaptations that await discovery.

### RECOMBINATION OF CHARACTERS

A word must now be said regarding the recombination of these adaptations into new varieties suited to new conditions or representing an improvement over varieties already existing.

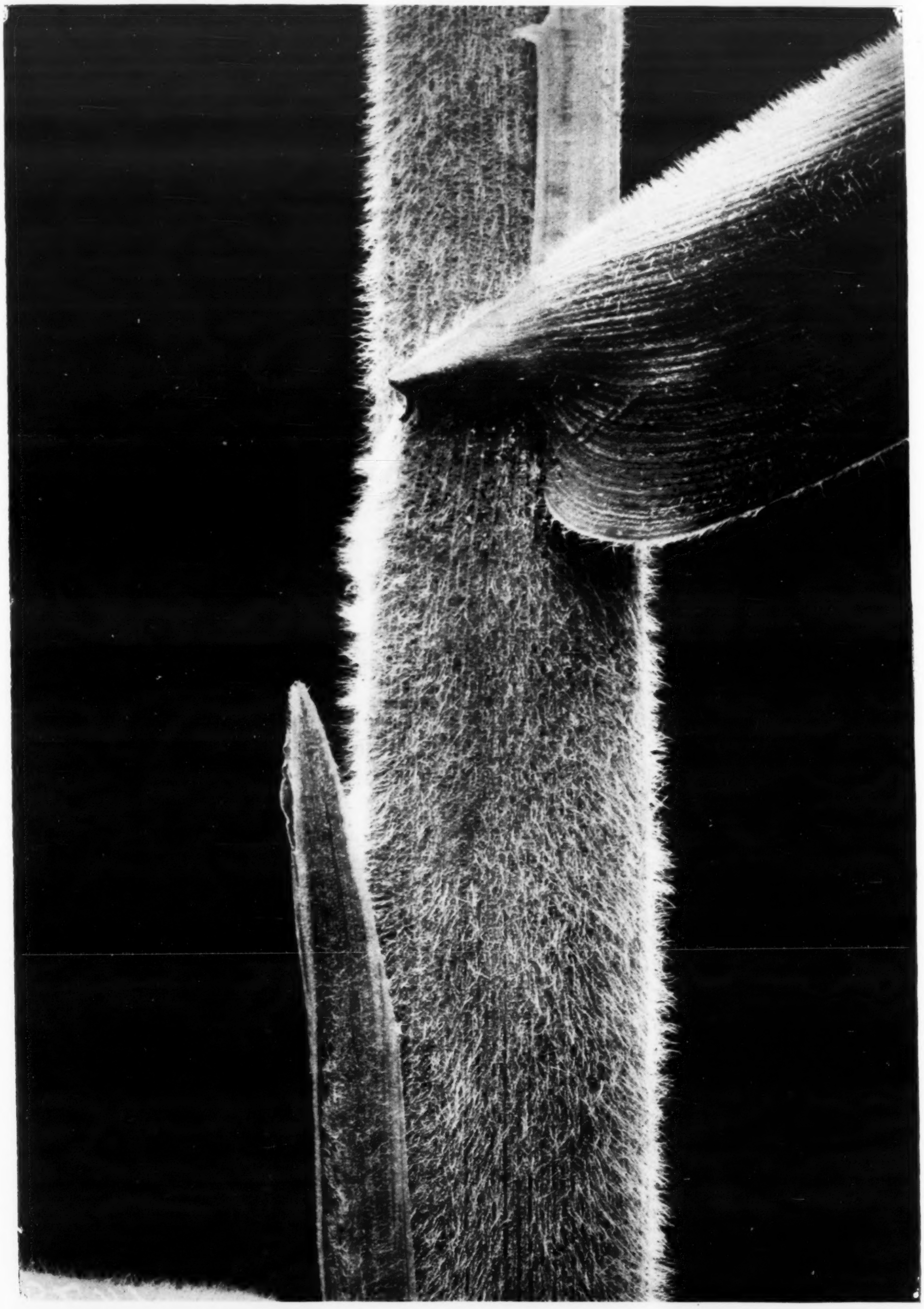
Regarding the recombination of characters, our knowledge is still very imperfect, but here also a beginning has been made and results sufficient to serve as demonstrations have been secured. An example may be taken that is particularly applicable to tropical America.

When a traveler from the north visits tropical America and finds maize a staple crop and often growing luxuriantly, he is naturally struck by the absence of table or sweet varieties so generally grown in this country. I have made inquiry in a number of instances and almost invariably have been told that sweet varieties have been introduced, but that they did not do well, and that their growth was given up on that account. If it were possible to combine the palatability of the sweet varieties with the luxuriant growth and freedom from insect attack of the native varieties, a valuable addition might be made to the rather meager list of really delicious vegetables available in many parts of the tropics. We are to some extent confronted with the same problem in our own southern states where the ravages of the corn worm practically preclude the growing of commercial varieties of sweet corn.

In the breeding of commercial varieties of sweet corn, one of the most important considerations has been earliness. In breeding for earliness the number of leaves has been reduced. In reducing the number of leaves the number of husks, which are homologous to leaves, have also been reduced with the result that the ears of sweet corn are poorly protected. This was of little or no importance north of the region infested by the corn worm, but it is this that renders the commercial sweet varieties unsuited to southern regions.

In 1912 crosses were made between commercial sweet varieties and southern varieties of field corn having well protected ears. The first generation plants were grown in 1913, and selections were made from those plants with the most perfectly protected ears. From the ears thus obtained, which contained a mixture of sweet and non-sweet seed, we selected the sweet seed for planting in 1914. In that season the plants were very variable, but all the seeds were sweet. Crosses were made between the most promising plants, special attention being again paid to the covering of the ears. The results of the past season demonstrated that we already have a fairly uniform and productive variety of sweet corn. Although grown in a region where the infestation of corn worms is particularly severe the damage to the ears was insignificant, less, in fact, than was the damage done to field varieties in the same region. Thus in three years we have combined the sweet seeds of the table varieties with well-protected ears of the larger field varieties. It would appear that there is no valid reason why any region that can grow maize successfully should be without sweet varieties. Whether earliness must necessarily be sacrificed, or whether it is possible to secure earliness and still keep the well-protected ears, is an interesting question that must await further investigation.

All characteristics cannot be manipulated as easily as the sweet endosperm, which from the alternative nature of its inheritance permits of



**A HAIRY VARIETY OF MAIZE.**

Leaf sheaths of the Esperanza variety of maize, showing the maximum development of tuberculate hairs. Photograph by courtesy of the *Journal of Agricultural Research*. (Fig. 3.)

Mendelian recombination, but our experiments indicate that most of the characters of maize are independent of one another in inheritance and that recombination is only a question of careful selection following hybridization.

CONCLUSIONS

The work of discovering new and valuable characteristics is one in which a coöperative arrangement among the different maize-growing countries of America would be especially applicable. Once an adaptation is observed and the discovery announced, it becomes available to all countries.

Of course, an important step to take is the interchange of varieties, but it is of equal importance to have the varieties studied in their native countries by observers familiar with the maize plant and its variations.

I would strongly urge that each of the maize-growing countries of America make a canvass of the maize varieties existing within its boundaries. In the study of these varieties the particular conditions under which they have developed should be kept in mind. Thus, if a variety is found growing in a region of cool nights, high winds, or any other pronounced environmental factor an effort should be made to determine how the variety meets the peculiar condition. I venture again to call attention to the necessity of looking for desirable adaptations rather than desirable varieties and to urge that no variety be overlooked simply because it appears insignificant or worthless. If a variety is growing under climatic conditions that are extreme in any particular, it is more than probable that the variety possesses valuable characteristics.

---

## Improper Feeding among New York School Children.

Thirty-three per cent of the girls and 38% of the boys in two New York public schools are suffering from improper feeding, due to ignorance of what constitutes a suitable diet under present conditions, according to studies made by New York social workers, utilizing the medical services of the Department of Health and the Association for Improving the Condition of the Poor.

The school lunch is considered a direct way of meeting the problem revealed by these studies Nutritional clinics have been established and a special committee of the pediatric section of the New York Academy of Medicine has been appointed to coöperate in the experiments now proposed. The first of these experiments is an extension of the existing school lunch service at School No. 40, East 20th Street, where twenty-five of the children are to be given one meal a day for three months. The Post Graduate Hospital, the New York School Lunch Committee, and the People's Institute are cooperating to bring the utmost of scientific control to the experiment and in making known the results in terms of physical improvement, scholarship, cost, and applicability of the results to school children generally.

The menus for the feeding experiment have been carefully worked out by Dr. Mary Schwartz Rose of Columbia University and Miss Lucy K. Gillette, dietitian of the Association for Improving the Condition of the Poor. These menus are to contain 900 calories. The foods selected are those most easily available to the people during the present war time crisis and those which should be used for purposes of conservation. The boys volunteered to eat these meals for a period of three months as "Food Scouts" to prove what food in war time children must eat in order to reach proper physical development.

# ADVERTISING NEW PLANT FOODS

## War Conditions Make Evident Necessity of Forming Food Habits of People Along Right Lines—This Work Should be Especially Directed by Department of Agriculture—Incessant Hammering of Modern Advertising Has Created a Vast Market For Many Commercial Products.

DAVID FAIRCHILD

*Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.*

THE days of the helter-skelter of democracy are drawing rapidly to a close. "The method of leaving the development of society to the confused welter of forces which prevail within it" must give way. We have "discovered the necessity and value of a conscious direction of its activities." The war is making this great change evident to everyone. We must know what we are doing as a people, and our habits—our likes and dislikes—must form the study of our most brilliant minds. The results of these studies must be taken to all the people with the same certainty as the advertisements of the great corporations are hammered home, until they become brain patterns on the mind of every man, woman and child, patterns as clear as, or clearer, than Coca Cola, Cascara, or Quaker Oats.

### FOOD HABITS OF VAST IMPORTANCE

Our food habits—why should they not form one of the very first and most important problems with which this conscious direction should concern itself? "Food will win the war" is now on every stamped envelope. If this is true, then the food habits of the people form one of the most vital problems at the present time, and are likely to do so for some years to come.

To the generation just past, paternalism was considered a great error, something that would undermine the morals of the people. My first experience in the introduction of plants into America was with this mistaken bugaboo of democracy.

I was asked, by the head of the Division of Horticulture of the Federal Department of Agriculture, to secure for a pioneer, who was trying to establish the citron industry on his place in the foothills near Los Angeles, some cuttings of the citron of Corsica. After the negotiations had proceeded so far that I was on my way to Corsica the matter came to the attention of the Secretary. "I would just as soon give a man a set of Plymouth Rock eggs as to get for him, at government expense, a lot of cuttings of the citron," was his reply. (And as a result I got the cuttings with my own money, and it was a long time before the Government ever paid me back.) This is a bit of department history that has never before been published.

Today the Office of Foreign Seed and Plant Introduction is expending a hundred thousand dollars a year in getting and handing over to just such pioneers as Smith, of Monrovia, Calif., new plant material from foreign countries.

### PRODUCTS SHOULD BE MADE KNOWN

It is now twenty years since this work was begun, and we have arrived at still another step in the progress towards paternalism which it is evident to me is necessary. This step is the conscious direction of the people in acquiring new food habits.

We have been aiding the new industries to get the material with which to begin; and the pioneers have been putting their lives and their money into the growing of the trees and the plants, and the acquiring of the necessary information with regard to their cultivation and the handling of the product, and

now they are ready to put their pet products on the market. But, alas, there is no market. They have convinced themselves that the fruit or the vegetable is better in some respects than what their neighbors are growing, and that there are good reasons why it should be grown over a considerable area of land, but they have spent all the money they could spare in the growing of their product and they have never considered the selling end. They have done what the farmer has done so often, neglected the selling end of the proposition.

### ADVERTISING TOO COSTLY

Now it is entirely beyond the limits of the pocketbooks of any man or small body of men to put up the money for the advertisement of a new vegetable. Advertising is expensive, and the prices paid by the big manufacturing firms would be out of the question for the producer of a new vegetable. He simply could not do it. Before one got back in sales the money which he put into advertising he would find that some one else was growing the same or a similar product and reaping the benefits.

Is this state of affairs to be always left to the helter-skelter competition of food manufacturers with secret processes, and the manufacturers of foods which are so well known that only superior quality counts anyway?

If it is important for the people that these new plants should be developed into plant industries, then it seems to me that a market for them must be created and the necessary advertising be done by the Government.

### MARKET HARD TO SECURE

This doctrine is the result of experience, not merely an office view of the situation. I have had the experience of seeing farmers become interested in a new industry, of seeing them plant several acres to a new crop, and then, when the harvest time came, discover that nobody was going to help them advertise the fruit or the vegetable; and, not being men of large means, their enthusiasm has melted away and the industry, which deserved a larger try-out and a fuller experience, has died out for lack of advertising. Had 1% of the money spent every month in the advertising of some new brand of chewing gum been available for the new and wholesome food, sales could have been made, the growers encouraged to go ahead, and a new plant industry established. In the one case a new chewing gum, made from the same ingredients as any other, has supplanted some other chewing gum with absolutely no good results as far as the public is concerned; in the other the death of an industry which would have brought new land areas under cultivation and made safer for the future our agriculture and more secure our food supplies of the future.

### DISEASES MUST BE COMBATTED

For it must not be supposed by the public that there is any certainty that we shall be able always to combat the epidemic diseases of plants. Nor must it be forgotten that these may gain in virulence with the extension of the areas planted. Nature is not made in any one mold, and each case will have to be fought out singly. We have spent hundreds of thousands of dollars trying to grow the old world grape in the Eastern States of America and have utterly failed. The history of the pioneers in the establishment of the American grape industry is illuminating in this connection. This industry deserved to have a much smoother path and to have sacrificed many less pioneers.

Under our very eyes today the same kind of a struggle is going on in the South where the delicious Scuppernong grape is being developed, and the growers are trying, without organization, and with only half-hearted government aid, in the form of advice and experimental work, to create a market for what is in reality a delicious new drink. At the same time a single concern with a mixture of California grape juices has worked up a trade in a new drink and is selling it by the carload. This new drink has been built up by concentrating capital on the simple mat-

ter of salesmanship. In the one case the growers of the Scuppernong grape cannot sell their product because they have no salesman and cannot afford to engage one. In the other, an already established industry creates a market for a new drink by skilful advertisement.

The question which I want to ask is: Why should not the Government have expert salesmen?

### LARGE FIELD FOR CORN AND RICE

Had the success of the corn campaign in Europe been followed up as it should have been years ago there is little doubt but that the ignorance which has prevented the Belgians and English from eating corn cakes and other corn products would have been immensely minimized. Had salesmen been employed to teach the people how to cook rice and encouraged its consumption we would have, instead of the paltry consumption of seven pounds per capita, something approaching the amount which we ought to consume. An active rice campaign might have prevented the overbalanced sugar consumption of 90 pounds which we now have, largely as the result of the advertising placards and newspaper urgings, and the incessant hammering of thousands of salesmen along the line of natural small resistance. These chocolate and candy and ice cream and sweet drink manufacturers have had free access to the public, and have developed in the children of the coming generation a sweet tooth which will require the sugar plantations of the West Indies and the East Indies as well to supply. And this, too, in the face of the fact that the sugar habit, like the alcohol habit, has objectionable features about it which the doctors have long ago pointed out.

The conscious direction of the food consumption of the people will, I conceive, bring into existence the government salesman, and with it the development of what has already come in other lines government advertising and government street car posters and fence advertisements.

### DISCRIMINATION AGAINST PRODUCTS

The newspapers and magazines have always looked upon the stories about new foods in the light of news, and they have always been glad to spread any items of interest which would help the sale of things in which the farmer is interested. They have drawn the line when it comes to the advertising of any manufactured product—that was advertising and should pay its way.

The path of the government salesman should be made easy since he would not be working for any one small set of men, but for the development of a new plant industry which would be free for all to enter, and would support, on the land, families which would add to the building up of the country. When the industry reached a stage where it could afford to organize and engage its own salesmen then would be the time for the Government to withdraw its support.

---

## Ohio Germination Tests Reveal Lack of Good Seed Corn.

Most of the corn harvested in Ohio in 1917 is not fit for seed, according to the Ohio Experimental Station, which has been testing nearly two thousand samples representing almost every county in the State. Crib and field lots range in germination from 1 to 40%.

Corn gathered and stored under artificial drying conditions before the freezing weather last December show 90 to 100% germination in these tests. Half of the corn kept from the crop of 1916 tests this high, and three-fourths of such samples are above 80%.

Seed corn this spring must come from three sources: A few farmers stored their corn early so that it was well dried out when cold weather came. Some corn matured comparatively early in southern counties and can be used in that part of the State. All old corn from 1916 should be held for seed and tested for germination.

Since local seed corn is always safest, from three sources: A few farmers to buy as near home as possible and to test each ear before planting.

# ANOTHER CHANCE FOR THE FILBERT

## Previous Attempts to Grow Filberts Along Atlantic Coast Failures—Layered Plants Now Growing Successfully in Maryland Suggest a Retrial of this Valuable Nut Tree in Eastern United States—Filbert Nuts Might Form a Valuable Addition to War Foods

AFTER repeated failures in trying to grow the European filbert successfully in the eastern United States, comes the report that layers brought into Maryland from introduced trees grown by the late Felix Gillet are exhibiting great vigor and unusual freedom from disease and are so promising as to suggest a retrial of these valuable nuts on the Atlantic Coast. In case they succeed in becoming well established and resistant to eastern diseases and pests, a vast field will be opened where eastern growers may compete with the exportations from the Old World. Although commercial growing in the northwest has been made an actuality during the last quarter of a century, immense opportunities for the development of the industry still remain.

The best varieties of the northwest, including the Barcelona and DuChilly, were developed by the late Felix Gillet. and for this reason, the Maryland trees may well be taken to be the most vigorous and resistant which can be produced. So far they have made a splendid showing. But it is very possible that it is because of an isolated position and because of the fact that they have not yet been exposed to attacks by the filbert blight that they have been immune. It will be necessary to have them more widely distributed and more exposed to infection before any definite claims for immunity can be set forth. The filbert blight has so far succeeded in destroying all European filberts which have been planted along the Atlantic coast, and may not yet have reached the new Maryland layered plants.

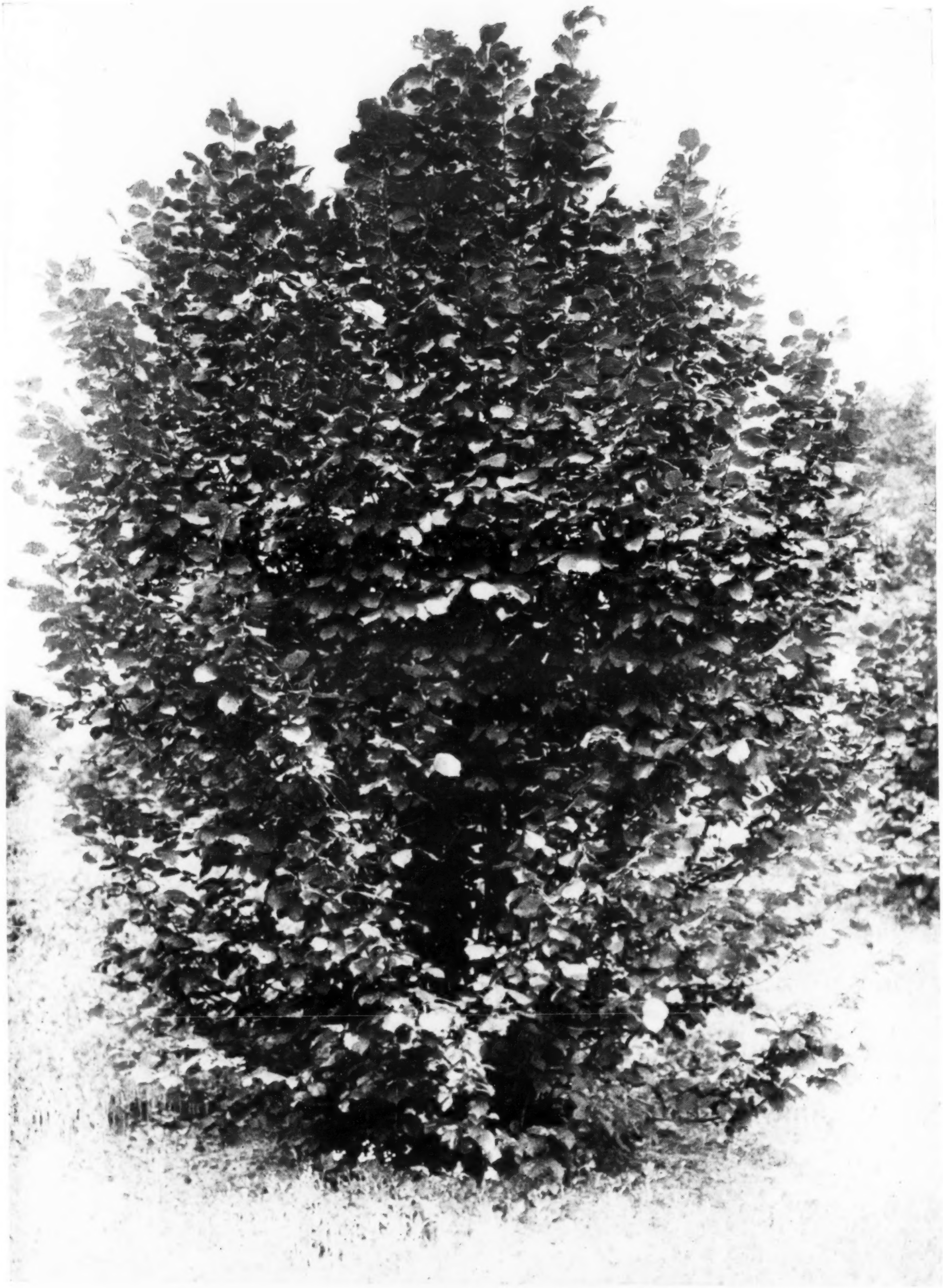
Although filberts have entered largely into the diet of the inhabitants of the Old World since an early epoch, being highly praised by Virgil himself, these delicious nuts of unusual food value have been almost in the nature of a curiosity in America, especially along the North Atlantic Coast, and except for an occasional importation sold in small quantities at such prohibitive prices as to make any use of the nut as a food product an impossibility, have been practically unknown to the general public.

Due to the fact that filbert exportations from the Old World amounted to millions of dollars annually, many attempts have been made to introduce the growing of filberts into this country, but it is only during the last quarter of a century that sufficient success has been attained to warrant plantations for commercial purposes. Even during this time, practically all the successes were scored in the western and northwestern parts of the United States, it seeming to be impossible to secure varieties that would do well along the Atlantic Coast.

There are two native species of filbert (*Corylus rostrata and C. americana*) which would appear to be of value in the American field, but due to their relatively small nuts are unable to successfully compete with the two European species (*C. Avellana* and *C. Colurna*). *C. Avellana* of which the Barcelona, Du Chilly and Géant des Halles are all varieties, seems to be on the whole the best adapted to American needs.

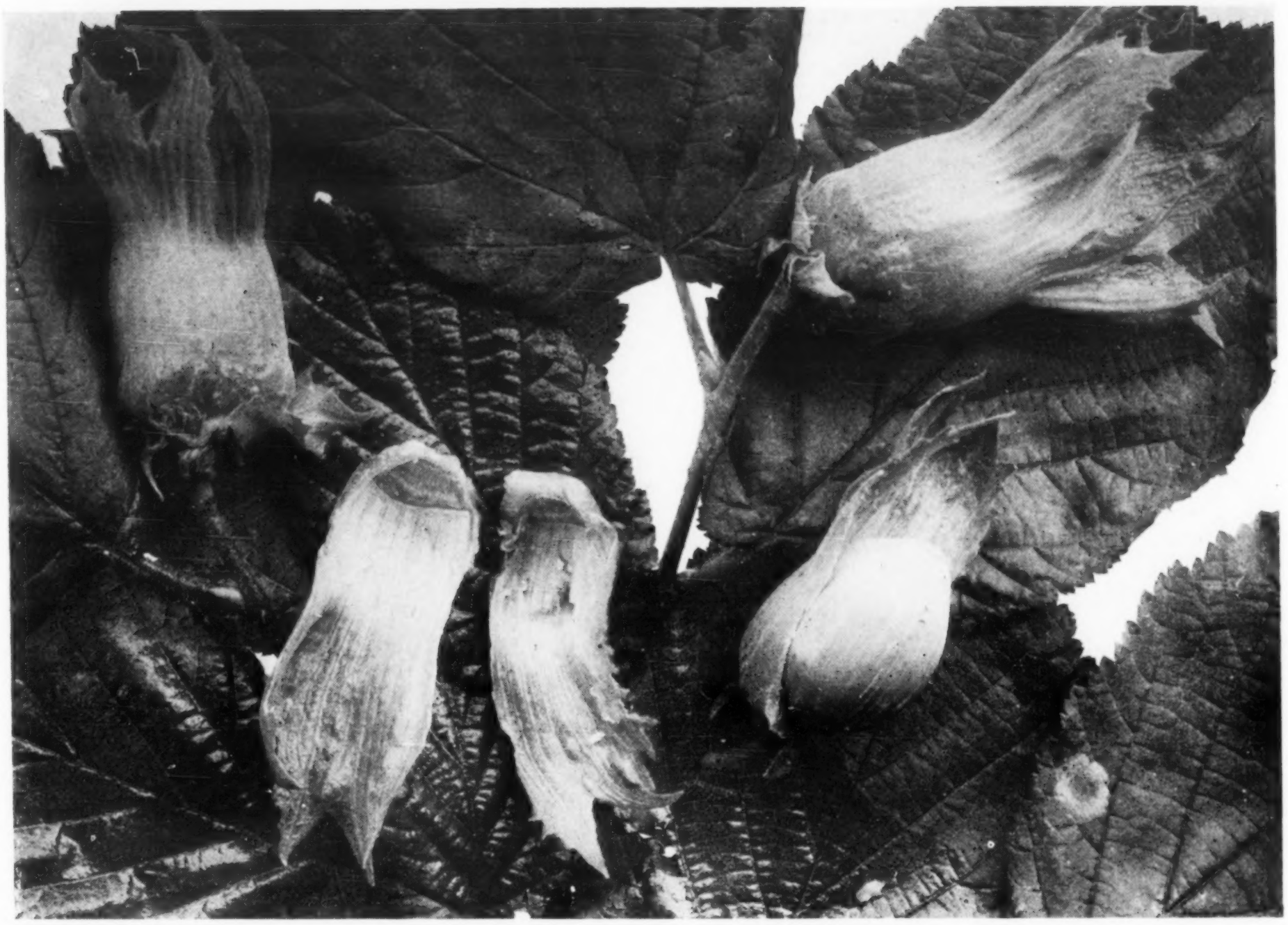
### NUT OF GREAT ANTIQUITY

The history of the filbert as a food product is lost in the mists of antiquity. It may have been known to the Romans as *Nux Pontica*, probably introduced from Pontus. The Italian name of *Avellana* seems to have been first applied to the wild hazel of Britain long before



**8-YEAR-OLD FILBERT IN MARYLAND**

Felix Gillet, of Nevada City, Cal., a French nurseryman and writer on the subject of filberts and almonds collected at his Barren Hill Nursery a number of the best European varieties of filberts. The illustration is of a tree of the *Géant des Halles* variety of *Corylus avellana* raised in Maryland from a layer of one of this collection. The great vigor and unusual freedom from disease of the whole collection and the fact that they bear regularly suggest the advisability of trying them again in the Eastern States on well-drained hillsides. (Fig. 4.)



THE BARCELONA VARIETY OF EUROPEAN FILBERT

Although our American hazelnuts (*Corylus americana* and *C. rostrata*) are familiar to most, the larger-fruited cultivated filbert of Europe (*Corylus avellana*), is still comparatively unknown in the Eastern states, except in the markets, and has only begun to attract attention in California, Oregon, and Washington. The behavior of several varieties brought into Maryland as layers from introduced trees grown by the late Felix Gillet of Nevada City, Cal., is so promising as to suggest a retrial of various varieties of this valuable nut on the Atlantic Coast. (Fig. 5.)

it was adopted by Linnaeus as the specific name of the indigenous species. Virgil states in Eclogue vii that it was more honored "than the vine, the myrtle or even the bay itself."

Members of the genus Corylus long enjoyed the distinction of being endowed with occult powers, and twigs from them were used as divining rods for locating treasures, veins of metal, subterranean water and even criminals, and this miraculous power is still believed in by many people at the present day. Although the powers were later attributed to other plants as well, most notably to the peach and the witch hazel the myth has always been connected principally with the Old World nut tree.

---

## Improvement of Beans in Manchuria

The *Manchuria Daily News* states that the South Manchuria Railway's agricultural station has been experimenting on the improvement of Manchurian beans for several years. Species from Ssupingkai have been distributed to different places.

The results in 1917 were favorable on the whole, and about 20% increase in the yield was realized. Moreover, the new output is superior in weight, percentage of oil, luster, etc. These seeds are to be more widely distributed in 1918.

# LETHAL FACTORS AND STERILITY

## Certain Factors Cause Death of Homozygous Embryos—Sublethal Factors or Combinations Also Affect the Zygote—Action on Pollen Grains and Embryosacs

JOHN BELLING, *Washington, D. C.*

### I. LETHAL FACTORS, OR COMBINATIONS OF FACTORS, ACTING ON THE ZYGOTE

A NOMINALLY recessive (actually intermediate) genetic factor, causing the death of all embryos homozygous for it, was demonstrated by Baur, in Antirrhinum, in 1907 (2). On selfing, the heterozygote, $Aa$, gave $1A_2{}^1 : 2Aa : Oa_2$ (1 green : 2 gold-color). Similar factors have been found in several other cases. In these plants, the embryos burst the seed-coats, and sometimes, as in maize, have a sufficient food store to grow leaves some inches long. But in *Oenothera lamarckiana*, as Renner (37) has shown, ½ of the embryos die in the seeds, without emerging. It is, I think, likely that such a mortality in the seed exists in other cases; probably in Vilmorin's dwarf wheat (52) which was constantly heterozygous, and gave approximately a ratio of $OA_2 : 2Aa : 1a_2$ (two dwarf to one tall) when selfed; and possibly also in many first-generation species hybrids.

In the heterozygote $Aa$, where $a_2$ is lethal, if any factor $B$ is linked with $A$, then a plant heterozygous for $AB$ will give progeny, as regards $B$, in the proportion of $(m^2+2mn)B_2 : 2(m^2+mn+n^2)Bb+(n^2+2mn)b_2$, where $m:n$ is the gametic ratio for coupling or repulsion. The resulting numerical ratios for coupling (Table I) show a deficit in recessives increasing as the coupling becomes closer, and a small excess in homozygous dominants, the ratio of dominants to recessives increasing from over 3 : 1 to an indefinite extent as the gametic ratio increases. For repulsion, on the other hand, there is a correspondingly large decrease in homozygous dominants and a small increase in recessives, the ratio of dominants to recessives varying with the gametic ratio from under 3 : 1 to a limit of 2 : 1. Hence, wherever there are lethal factor combinations, as in species crosses, we may expect to meet with ratios of dominants to recessives in the second generation differing from the usual 3 : 1 ratio, because of linkage and crossing-over. I have shown (7) that crossing-over occurs in some species crosses.

TABLE I

Ratios in progeny of $AaBb$ plant, where $a_2$ is lethal, and $A$ and $B$ are linked.

| Gametic ratios $AB$ or $ab$: $Ab$ or $aB$ | $B_2 : Bb : b_2$ | Dom.: Rec. |
|---|---|---|
| 2 : 1 | 8 : 14 : 5 | 4.4 : 1 |
| 5 : 1 | 35 : 62 : 11 | 8.8 : 1 |
| 10 : 1 | 120 : 222 : 21 | 16.3 : 1 |
| 100 : 1 | 10200 : 20202 : 201 | 151.3 : 1 |
| 1 : 2 | 5 : 14 : 8 | 2.4 : 1 |
| 1 : 5 | 11 : 62 : 35 | 2.1 : 1 |
| 1 : 10 | 21 : 222 : 120 | 2.0 : 1 |
| 1 : 100 | 201 : 20202 : 10200 | 2.0 : 1 |

In the case of *Oenothera lamarckiana*, the death of half the embryos, as well as the results of crossing, are met by Renner's hypothesis; that, after selfing, a pair of factors, or combinations of factors, are lethal to the zygote, when homozygous; so that $L_2$ and $l_2$ are eliminated, and only $Ll$ embryos left. Then a factor $B$, linked with $L$, will be found in the proportions of $mnB_2 : (m^2+n^2)Bb : mnb_2$, the numerical results being given in Table II.

TABLE II

Ratios in the progeny of an $LlBb$ plant, when $L_2$ and $l_2$ are lethal combinations, and $L$ and $B$ are linked.

| Gametic ratio | $B_2 : Bb : b_2$ | Dom.: Rec. |
|---|---|---|
| 2 : 1 or 1 : 2 | 2 : 5 : 2 | 3.5 : 1 |
| 5 : 1 or 1 : 5 | 5 : 26 : 5 | 6.2 : 1 |
| 10 : 1 or 1 : 10 | 10 : 101 : 10 | 11.1 : 1 |
| 100 : 1 or 1 : 100 | 100 : 10001 : 100 | 101.0 : 1 |

There is here a large excess of heterozygotes, increasing rapidly with the intensity of the linkage, the results for coupling being the same as those for repulsion.

II. SUBLETHAL FACTORS, OR FACTOR COMBINATIONS, AFFECTING THE ZYGOTE

These factors usually cause the death of a fraction only of the zygotes possessing them, the mortality varying with the environment from zero to perhaps *total*. *Selective elimination*, or *differential viability*, are terms often applied to this mortality, which may be found in the second generation of plant crosses, especially wide crosses. When vicinism is absent, the presence of sublethal factors may often be recognized by the abnormal ratios in the second generation, which usually include a lessened proportion of recessives. A back-cross of $F_1$ with a full recessive best shows this differential viability. In Matthiola, Saunders (40) found the heterozygote 1 to 1 double-thrower to have a sublethal factor combination. In flax, Tammes (46) ascertained that in a cross of blue and white-flowered races, in a progeny of 4,000 plants, there was always a deficit in the recessive white-flowered. The white-flowered plants were found to have 13% fewer seeds in a seed vessel than the blue-flowered plants of the same family: and of the seeds the white-flowered plants produced, a smaller percentage germinated than of those from the blue-flowered. Hence $a_2$ was sublethal to the embryos. ($Aa$ plants, however, were apparently just as viable as $A_2$ plants.) After reckoning in the observed mortality, the ratios agreed with expectation.

If a recessive sublethal factor $a_2$ is the cause of selective elimination in the case of $x$ of the individuals possessing $a_2$ in the second generation; then a factor $B$ being linked with $A$, there will be found, among the $n$ surviving plants of the second generation, $3x$ plants which will be with regard to $B$ in the proportions $(m^2+2mn)B_2: 2(m^2+mn+n^2)Bb: (n^2+2mn)b_2$; while the $n+3x$ remaining plants of the second generation, in which $a_2$ was not present or was not eliminated, will be in the ordinary proportion of $1B_2: 2Bb: 1b_2$. It was shown above that the former of of these two proportions gives ratios greater than 3:1 for coupling, and less for repulsion. Hence, in all cases where a factor $B$ is linked with a sublethal factor, $A$ or $a$, the second-generation ratios will differ from the normal, not only for $A$ and $a$, but also for all other differential factors in the same chromosome pair.

III. LETHAL FACTORS, OR FACTOR COMBINATIONS, ACTING ON THE POLLEN GRAINS AND EMBRYOSACS (HAPLOID GENERATION).

These factors cause partial sterility, where only a definite fraction of the pollen grains and embryosacs remain viable. They cause a selective elimination of pollen grains and embryosacs, and their effect must be distinguished from that of zygotic factors which also may cause a total abortion of pollen grains (as in the recessive sweetpea with aborted pollen, 18), or of embryosacs (as in some double petunias), or partial abortion (as I have found in some $F_3$ families from Stizolobium crosses); but do not cause selective elimination among members of the haploid generation.

A special case of partial sterility due to lethal combinations of factors is *semi-sterility*, where half of the pollen grains and half of the embryosacs perish because of their possession of such lethal combinations. Semi-sterility has been especially studied in three Stizolobium crosses (5 and 6), where a satisfactory hypothesis was that each of the two combinations of factors, $KL$ and $kl$, not found in the original parents, was lethal; while either of the two combinations, $Kl$ and $kL$, peculiar to the parents, was not lethal. $H$ and $P$ were factors (for lateness of flowering, and pigmentation of seedcoat) linked with $K$. In $F_2$, both $H$ and $P$ occurred in the usual 3:1 ratio, notwithstanding the elimination of pollen grains and embryosacs. But the second generation consisted of fertile and semi-sterile plants in equal numbers. Among these two classes, the factor $H$,

for example, was to be expected in the following different proportions.

| | $H_2$ | $Hh$ | $h_2$ |
|---|---|---|---|
| Fertile plants.... | $(m^2+n^2)$ | $4mn$ | $(m^2+n^2)$ |
| Semi-sterile plants. | $2mn$ | $2(m^2+n^2)$ | $2mn$ |

With a gametic ration of 5:1, which approximates the figures actually found, the plants would be in the following proportions (7).

| Gametic ratio, 5:1 or 1:5 | $H_2$:$Hh$:$h_2$ | Dom.: Rec. |
|---|---|---|
| Fertile plants..... | 26 : 20 : 26 | 1.8 : 1 |
| Semi-sterile plants .. | 10 : 52 : 10 | 6.2 : 1 |

The fertile plants have a large excess of homozygotes, and the semi-sterile plants a corresponding excess of heterozygotes. The results for coupling are the same as those for repulsion.

In the case of Oenothera lamarckiana, which Geerts (16) has proved to be semi-sterile in pollen and embryosacs, we may use the same hypothesis as for the Stizolobium crosses; in which case the fertile combinations, $K_2l_2$ and $k_2L_2$, perish as embryos, and only the semi-sterile plants, $KkLl$, survive, the proportions in the second generation with regard to any factor $B$ which is linked with $L$ being, for either coupling or repulsion,

$$B_2 : Bb : b_2$$
$$mn : (m^2+n^2) : mn.$$

This gives a large excess of heterozygotes. We get precisely the same result as regards linkage if we take up the alternative (and perhaps more probable) hypothesis of a pair of allelomorphs, $Aa$, one of which is lethal to the pollen grains which contain it, and the other lethal to the megaspores having it. In this case, however, a separate factor pair, $C_2$ and $c_2$, must be regarded as responsible for the death of half the embryos.

In the double-throwing stock (Matthiola) which gives about equal numbers of singles and doubles, the facts (40) may, I think, be met by the hypothesis that this plant, in addition to being heterozygous for a factor $E$ (double plants having $e_2$), differs from the normal wild form in that the factor $E$ has undergone a mutation to $E^1$, $E^1$ being lethal to pollen grains. Then any factor $B$ (white-flower color as opposed to cream) linked with $E^1$, will give, in the progeny of the heterozygote $E^1eBb$,

| Plants with | $B_2$ | $Bb$ | $b_2$ |
|---|---|---|---|
| Normal flowers..... | $mn$ | $m^2+n^2$ | $mn$ |
| Neuter double flowers... | $n^2$ | $2mn$ | $m^2$ |

This gives (with close coupling) many $Bb$ and very few $B_2$ and $b_2$ plants among the singles, and mostly $b_2$ plants with few $Bb$ among the doubles (40).

Some extensive investigations of the mortality of pollen grains in known and suspected hybrids have been made lately, especially by Jeffrey (21 and 22), Dorsey (13), Standish (43), Hoar (19), and Cole (10). Further work of a quantitative nature on the amount and inheritance of this mortality, and on the state of the embryosacs of these hybrids, is needed before a factorial hypothesis can be applied. There are several distinct causes for empty pollen grains (and for aborted embryosacs, which, however, are not readily counted). (1) There is a mortality due to accidents of environment; in which case the lethal effect is usually different in different flowers on the same plant, or in different plants of the same homozygous line, or at different times of the year. Cold, at a critical period of pollen formation, in the spring or fall, affects the pollen of some tropical plants; as Stizolobium, or cotton (1). This mortality is apparently not selective, and presumably does not affect the ratios of zygotes. (2) There is a partial mortality of pollen grains due to zygotic factors, which factors I have found cause the death of usually a small fraction of the pollen grains in certain fertile and semi-sterile lines from Stizolobium crosses. This tendency is inherited, but is apparently random, not selective. (3) The whole (or nearly the whole) of the pollen of a plant may perish by the action of zygotic factors, as in the sweet-pea with empty anthers. In these cases the abortion is not selective. (4) Lethal factors, or combinations of factors, acting on the haploid generation may cause semi-sterility; that is, the death of half the pollen grains and half the em-

bryosacs. In this case the elimination is selective, and the $F_2$ ratios are altered for fertile and semi-sterile plants, and for cases of linkage. (5) There may be selective partial elimination of pollen grains or embryosacs by sublethal factors (though this has not yet been proved for any one case). It would of course immediately affect the $F_2$ ratios and linkage, if at all extensive.

Since two or more of these causes of mortality of pollen grains and embryosacs may occur in the same plant, even to determine for instance whether a hybrid plant is precisely semi-sterile or not may require an examination of the pollen from many flowers, and in some cases (as in Citrus species hybrids) for several seasons in succession.

LITERATURE

(1) Balls, L. 1909, Rept. of Am. Breed. Assn., 5: 16. Abortion of Pollen Greatest in Cold Weather (in cotton).

(2) Baur, E. 1907, *Ber. Deutsch. Bot. Ges.*, 25: 442. Lethal Intermediate Factor in Snapdragon (chlorophyll factor).

(3) Baur, E. 1914, Einf. in die exp. Vererbungslehre, 2 Aufl., Berlin, p. 98. Sublethal Recessive in Snapdragon (color factor).

(4) Beach, S. A. and Maney, T. J. 1912, Rept. of Am. Breed. Assn., 8: 214. Recessive Disease Factor in Prunus Cross.

(5) Belling, J. 1914, *Zeitsch. f. ind. Abst. u. Vererbungslehre*, 12: 303. Inheritance of Semi-sterility Due to Lethal Combinations (in Stizolobium).

(6) Belling, J. 1915, Fla. Agr. Exp. Sta. Rept. for 1914: 96. Inheritance of Semi-sterility in Later Generations.

(7) Belling, J. 1915, *Am. Nat.*, 49: 582. Linkage of Late Flowering and Pigmentation of Seed Coat with One Factor for Semi-sterility.

(8) Biffen, R. H. 1905, *Jour. Agr. Sci.*, 1: 4. Selective Elimination Found in Second-Generation Families of Wheat.

(9) Biffen, R. H. 1907, *Journ. Agr. Sci.*, 2: 109. A Sublethal Dominant Disease Factor in Wheat.

(10) Cole, R. D. 1917, *Bot. Gaz.*, 63: 110. Pollen Abortion in Rosa.

(11) Correns, C. 1913, *Zeitsch. f. ind. Abst. u. Vererbungslehre*, 10: 130. A Recessive Sublethal Factor in Mirabilis.

(12) Davis, B. M. 1915, *Proc. Am. Philos. Soc.*, 54: 226. Selective Elimination and Sterity in Oenothera.

(13) Dorsey, M. J. 1914, Minn. Agr. Exp. Sta. *Bull.* 144. Pollen Abortion in Hybrid and Other Grapes.

(14) East, E. M. 1915, *Proc. Am. Philos. Soc.*, 53: 70. Pollen Abortion and $F_2$ Elimination in Nicotiana Cross.

(15) Emerson, R. A. 1912, Nebr. Agr. Exp. Sta. Rept., 25: 89. Lethal Recessive in Maize (chlorophyll factor).

(16) Geerts, J. M. 1909, *Rec. des Trav. Bot. Néerl.*, 5: 93. Semi-sterility of Oenothera Lamarckiana, and of many Onagraceae.

(17) Gregory, E. S. 1907, *Journ. of Bot.*, 45: 377. Pollen of Hybrid Violets.

(18) Gregory, R. P. 1905, Proc. Camb. Philos. Soc., 13: 148. Pollen Abortion in Sweet-pea.

(19) Hoar, C. S. 1916, *Bot. Gaz.*, 62: 370. Pollen Abortion in Rubus.

(20) Janczewski, E. 1908, *Bul.* Acad. Sci. Cracovie. Math. Nat., 1908: 587. Pollen Abortion in Ribes Hybrids.

(21) Jeffrey, E. C. 1914, *Bot. Gaz.*, 58: 322. Abortion of Microspores or Pollen grains in Many Hybrids and Presumed Hybrids.

(22) Jeffrey, E. C. 1915, *Am. Nat.*, 49: 1. Pollen of Crypthybrids.

(23) Jesenko, F. 1913, *Zeitsch. f. ind. Abst. u. Vererbungslehre*, 10: 311. Pollen Abortion in Wheat-rye Cross; First Generation Substerile.

(24) Jones, W. N. *Journ. Genetics*, 2:71. Sub-sterile Digitalis Species Cross.

(25) Juel, H. O. 1900, *Jahrb. f. wiss. Bot.*, 35: 638. Pollen Abortion in Presumed Hybrid Syringa.

(26) Kupffer, K. R. 1905, *Acta Hort. Bot. Univ. Imp. Jurjevensis.* 6: 1. Pollen Abortion, A Test for Species Hybrids.

(27) Lidforss, B. 1914, *Zeitsch. f. ind. Abst. u. Vererbungslehre*, 12: 1. Pollen Abortion in Rubus Crosses.

(28) Lindstrom, E. W. 1917, *Am. Nat.*, 51: 224. Linkage with A Chlorophyll Factor in Maize.

(29) Miles, F. C. 1915, *Journ. Genetics*, 4: 193. Lethal and Sublethal Chlorophyll Factors in Maize.

(30) Muecke, M. 1908, *Bot. Zeit.*, 66: 1. Acorus Calamus, Aborted Pollen and Embryosacs.

(31) Nilsson-Ehle, H. 1912, *Zeitsch. f. Pflanzenzuechtung*, 1: 3. Sublethal Combinations in Wheat.

(32) Nilsson-Ehle, H. 1913, *Zeitsch f. ind. Abst. u. Vererbungslehre*, 9: 289. Recessive Lethals in Wheat and Barley (chlorophyll factors).

(33) Orton, W. A. 1911, Rapp. 4e. Conf. internat. de Génétique., Paris, p. 247. Sublethal (disease) Factors.

(34) Osawa, I. 1912, *Journ. Coll. Agr. Imp. Univ., Tokyo*, 4: 83. Pollen and Embryosac Abortion in Citrus.

(35) Osawa, I. 1913, *Journ. Coll. Agr., Tokyo*, 4: 237. Abortion of Pollen and Embryosacs in Daphne odora.

(36) Pellew, C. and Durham, F. M. 1916, *Journ. of Genetics*, 5: 159. Abortion of Over Half the Pollen of a Diploid Primula Species Hybrid.

(37) Renner, O. 1914, Flora, N. F., 7: 115. Abortion of Zygotes in Oenothera lamarckiana and Its Crosses.

(38) Rosenberg, O. 1909, K. Sv. Vetenkaps. Akad. Handl., 43, No. II. Abortion of Pollen and Embryosacs in a Sub-sterile Drosera Hybrid.

(39) SALAMAN, R. N. 1910, *Jour. Linn. Soc.*, 39: 301. Pollen Abortion in Potato. Effects of Season.

(40) SAUNDERS, E. R. 1911 and 1915, *Jour. of Genetics*, 1: 303 and 5: 137. Sublethal Factor Combination in Matthiola.

(41) SHULL, G. H. 1914, *Zeitsch. f. ind. Abst. u. Vererbungslehre*, 12: 97. Recessive Sublethal Factor in Bursa.

(42) SHULL, G. H. 1914, *Ber. d. Deutsch. Bot. Ges.* 31; *Gen. Vers. Heft.*: 40. Lethal and Sublethal Factors (for chlorophyll) in Melandrium.

(43) STANDISH, L. M. 1916, *Journ. of Heredity*, 7: 266. Pollen Abortion in Crataegus.

(44) STOMPS, T. J. 1912, *Ber. d. Deutsch. Bot. Ges.*, 30: 406. Abortion of Zygotes in Oenothera Crosses.

(45) SUTTON, A. W. 1914, *Journ. Linn. Soc. Bot.*, 47: 427. Sterility and Fertility of Species Crosses in Pisum.

(46) TAMMES, T. 1914, Kon. Akad. v. Wetensch., Amsterdam, 16: 1021. Quantitative Study of Sublethal Recessive in Flax.

(47) FISCHLER, G. 1903, *Beih. Bot. Centralbl.*, 15: 408. Abortion of Embryosacs in Ribes and Syringa Hybrids.

(48) FISCHLER, G. 1906, *Ber. d. Deutsch. Bot. Ges.*, 24: 83. Abortion of Pollen and Embryosacs in a Bryonia Species Hybrid.

(49) FISCHLER, G. 1906, *Jahrb. f. wiss. Bot.*, 42: 545. Pollen Abortion in Ribes Hybrids.

(50) FISCHLER, G. 1908, *Archiv. f. Zellforschung*, 1: 33. Pollen Abortion in Hybrids of Mirabilis, Potentilla, and Syringa.

(51) FISCHLER, G. 1910, *Archiv. f. Zellforschung*, 5: 622. Pollen Abortion in Bananas with Different Chromosome Numbers.

(52) TROW, A. H. 1916, *Journ. of Genetics*, 6: 66. Recessive Lethals in Senecio (chlorophyll factors).

(53) VILMORIN, P. DE. 1913, *Journ. of Genetics*, 3: 67. Lethal Factor, Probably Dominant, in Wheat.

(54) WETTSTEIN, R. v. 1908, Wiesner–Fetschrift, p. 368. Sempervivum Hybrids with Less Pollen Abortion when Grown from Cuttings.

(55) WHITE, O. E. 1913, *Am. Nat.*, 47: 206. Pollen Abortion in Abnormal Anthers of Fasciated Strain of Tobacco.

## Improvement of Labor Conditions for Women in France

Early in the war, it became realized in France that the absence of men and heavy responsibilities on women were causing many conditions to exist which could not but be detrimental to the race. One of the chief of these was work in factories for women and more especially night work. Although laws regulating such labor have been passed, frequent exemptions have been granted. A circular dated June 29, 1916, states *Commerce Reports*, prescribed certain limits for the employment of women at night. Then gradually employers themselves undertook to restrict further the night employment of female labor, with the result that an investigation begun by the Ministry of Labor on May 31, 1917, shows that female labor at night has been reduced to almost insignificant proportions.

It is reported that improvements have been made everywhere in the conditions and circumstances affecting the night work of the women. Husband and wife are employed at the same hours, so that they may take their meals together; there are eight-hour shifts, so that night work is required of each shift only one week in three; women are entrusted with the lighter kinds of work; the rest periods have been made more numerous; female workers living in the same quarter of the town are grouped together in the factory.

In the belief that further modifications might be made without jeopardizing the national defense, the committee in charge of female labor conditions gave expression to a number of desiderata to be put into effect. It is urged that no girls under eighteen years of age be employed at night, and that night work for women in no case be permitted to last longer than ten hours. It is also urged that night work for females of all ages, tolerated since the beginning of the war by suspension of the rules on this subject, shall be suppressed whenever the conditions affecting the supply of raw materials, of motive power, and of labor are such as to make it possible to obtain the same output by means of day labor alone; that when the output of a factory is decreased night work be curtailed first of all for women; that whenever the hours of labor are decreased, the reduction apply first to night work; that, so far as possible, mobilized married laborers be sent by preference to shops and factories in which their wives are employed.

# AN ANOMALY OF WHEAT ANTHERS

S. A. Anthony, *Chicago, Ill.*

ON a head of wheat grown in a greenhouse of the United States Department of Agriculture, at Arlington, Virginia, an interesting anomaly of the anthers was observed, which, as far as the writer knows, has not been previously reported.

The literature of teratology is very large, especially the observation of cases of metamorphosis of anthers into petals in composite flowers, and in the transformation of the integuments of the ovary into leaves. Teratologic phenomena in plants may arise from different causes. The usual consequence is the metamorphosis of a sexual organ into a vegetative one. Whether these are of pathologic or physiological origin, the cause can hardly be separated from a physico-chemical stimulus of the protoplasm arising from the production or liberation of substances (hormones) which produce the metamorphosis.

According to Goebel, the stamen of the Gramineae (Goebel, K. Vergleichende Entwicklungs geschichte der Pflanzenorgane, p. 118; Goebel K. Organographie der Pflanzen, 1913, p. 329) is a sporophyll originated by the transformation of a primordium (*Anlage*) of a foliage leaf. It produces the microspores, and before the appearance of the spore-forming tissue is a four-angled body, in every angle of which a sporangium is differentiated. The two pollen-sacs with the filament form the anther, being united by the connective.

In Phyllody the stamens are transformed either to foliage leaves or to petals. Goebel (*loc. cit.*) explains this through the action of the factors which cause the transformation of the leaf primordium into a petal, on the primordium of the stamen, causing the sporophyll to transform before the formation of the pollen-sacs.

In a case coming under the notice of the writer, however, only half of the sporophyll was transformed, and not into a leaf or a petal, but into a process bearing stigma hairs. As can be seen in Fig. 6, one-half the anther tip is transformed into a stylus with stigma hairs, practically a complete stigma. In Fig. 7 the transformation is very incomplete and the hairs formed suggest the toothing of the awn. It has been previously noted in barley that the awn is physiologically correlated to the stigma. In the modified stamen the filament invariably unites with the affected part and forms practically one body.

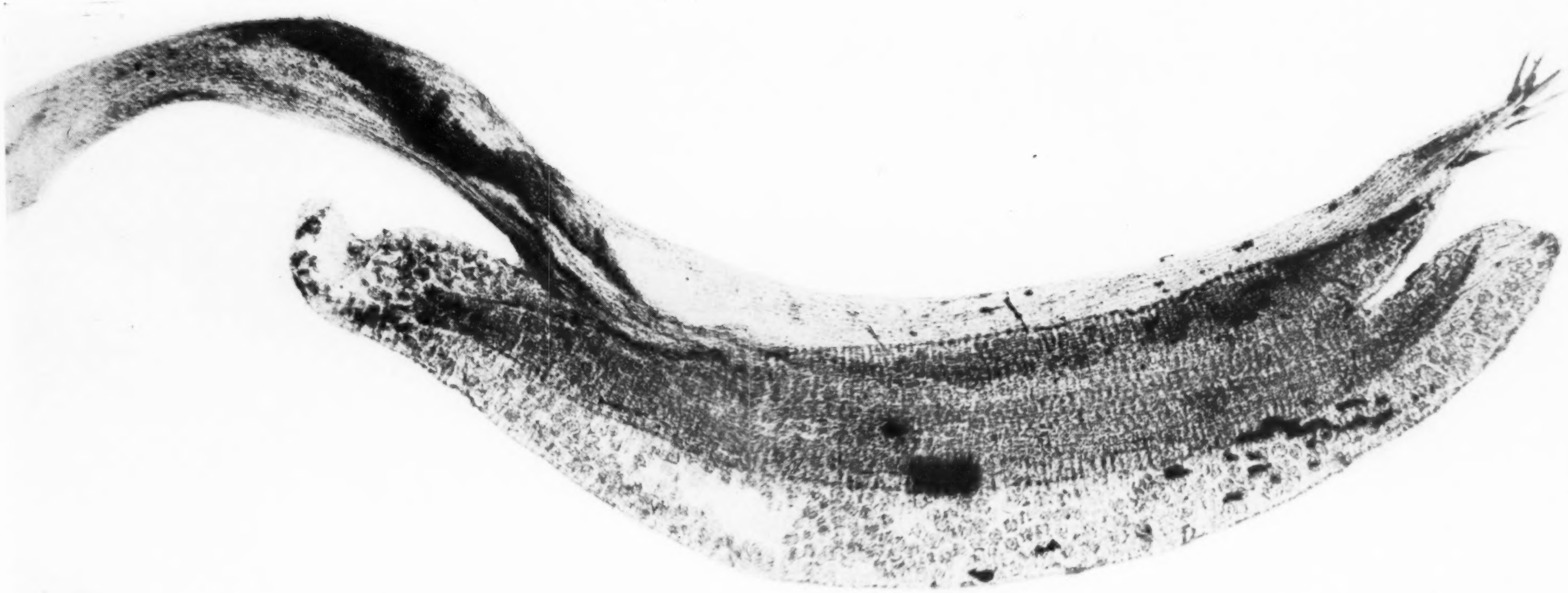
That the explanation given for Phyllody cannot be completely applied in this case is obvious, because genetically the stigma hairs belong to the carpels, and are very closely related to the embryo forming leaf structure.

That an organ-forming substance of a different organ may have influenced the Anlage of the sporophyll is possible, as suggested by Sachs and Loele. (Sachs Ueber Wachstums periode und Bildungsreize. Flora, 1893, p. 217. See also J. Loele, Bot. Gazette, 1915, Vol. 60, p. 249; Vol. 62, p. 293; 1917, Vol. 63, p. 25.) Goebel (*loc. cit.*) considers hormones and changes of the concentration of the protoplasmic fluids as possible explanations.

The fact that this anomaly has been found in the greenhouse suggests that abnormal physical factors of temperature or moisture may have a bearing on this phenomenon.

**AN ABNORMAL ANTHER**

Tip of an anther, one half of which is normal; the other half is transformed into a stigma branch. (Fig. 6.)



**AN ANOMALOUS ANTHER OF WHEAT**

An anther similar to that in Fig. 6 transformed to a lesser degree. Note the attachment of the filament to the modified half. (Fig. 7.)

# RECIPROCAL BREEDING IN TOMATOES

## Study Made in Order to Compare Relative Values of the Two Directions of the Cross—Certain Characters in Plants Correlated with Weight and Size of Fruits

BYRON D. HALSTED
*Botanist, N. J. College Agricultural Experiment Station, New Brunswick, N. J.*

FOR THE purpose of studying the relative values of the two directions of the cross in reciprocal breeding two kinds of tomatoes were selected that had at least four contrasting characters. The Dandy Dwarf variety (158) with its dwarf plants, having yellow foliage and coarse leaves and red fruits was combined with the Yellow Cherry (183), a standard sort with green foliage and fine leaves and yellow fruit. The union in two opposite directions was between but one plant of each kind, that is, the plant *a*–a, Dandy Dwarf, was bred upon the plant $b \frac{a}{(b)}$ representing the Yellow Cherry, and the reciprocal was between the same two plants, namely $\frac{b}{a}$.

During the season of 1917 the study was mainly between the two sets of plants of the second generation, but, as is the general rule, a small number of $F_1$ plants as well as of the two parental kinds were grown.

The Dandy Dwarf is a fair average of the kinds that are of low stature with short branches and thickly-set leaves. It bears red fruits that are broader than long and weigh near 24 grams. The Yellow Cherry is a tall-growing variety, with green foliage, fine leaves and yellow fruits of near a fourth (5.4 gr.) of the weight of the Dandy Dwarf, and not far from a half as long and broad as the red fruits of its breeding mate, as shown below:

| | Plant | Foliage | Leaf | Fruit | Weight | Length | Width |
|---|---|---|---|---|---|---|---|
| | | | | | *Gr.* | *Mm.* | *Mm.* |
| Dandy Dwarf (158)..... | Dwarf | Yellow | Coarse | Red | 23.80 | 27.70 | 37.40 |
| Yellow Cherry (183)..... | Standard | Green | Fine | Yellow | 5.40 | 16.70 | 19.40 |

The $F_1$ plants were all standard, green, fine, red and with the following fruit-weights and sizes:

| | *Gr.* | *Mm.* | *Mm.* |
|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry F1.. | 16.29 | 25.99 | 32.80 |
| 2. Yellow Cherry upon Dandy Dwarf F1.. | 16.47 | 28.42 | 34.02 |

The $F_1$ plants, with Yellow Cherry as the seed parent yield lighter and smaller fruits than the reciprocal. The greatest difference is in the length, namely 9.35%. In other words, the fruit characters of the seed parent are approached in both unions.

Records of each $F_2$ plant were taken for the following characters, namely, type of plant (whether standard or dwarf) the color of foliage (whether green or yellow) the kind of leaves (whether fine or coarse "potato-leaved") color of fruit, (whether red or yellow). Five fruits from each plant were weighed singly and measured for both length and width. The fruits were taken at random when fully ripe, and the picking and measuring were done by a student who had no knowledge of the purpose the records were afterwards to serve.

From the records 126 $F_2$ plants have been taken from each of the two sets. In one of the crosses this was the total number that had each of the several items in full and without flaw. In the reciprocal the first 126 plants with complete record were used.

Table I shows the results for the four

pair of characters that bred as dominants and recessives.

The theoretical Mendelian ratio calls for 94.5 for the dominant, and 31.5 for the recessive characters. Table I shows that the standard plants are much in

TABLE I

| Direction of the cross | Number of plants | Plants | | Foliage | | Leaves | | Fruit | |
|---|---|---|---|---|---|---|---|---|---|
| | | Standard | Dwarf | Green | Yellow | Fine | Coarse | Red | Yellow |
| 1. Dandy Dwarf upon Yel-Cherry $F_2$ | 126 | 106 | 20 | 96 | 30 | 91 | 35 | 96 | 30 |
| 2. Yellow Cherry upon Dandy Dwarf $F_2$ | 126 | 106 | 20 | 99 | 27 | 85 | 41 | 97 | 29 |

TABLE II

| | Plants | Number of plants | Green foliage, per cent | Yellow foliage, per cent |
|---|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry | Standard | 106 | 74.5 | 25.5 |
| | Dwarf | 20 | 85.0 | 15.0 |
| 2. Yellow Cherry upon Dandy Dwarf | Standard | 106 | 81.1 | 18.9 |
| | Dwarf | 20 | 65.0 | 35.0 |
| Both Crosses combined | Standard | 212 | 77.8 | 22.2 |
| | Dwarf | 40 | 75.0 | 25.0 |

TABLE III

| | Plants | Number | Fine leaves, per cent | Coarse leaves, per cent |
|---|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry | Standard | 106 | 69.8 | 30.2 |
| | Dwarf | 20 | 85.0 | 15.0 |
| 2. Yellow Cherry upon Dandy Dwarf | Standard | 106 | 70.9 | 29.1 |
| | Dwarf | 20 | 60.0 | 40.0 |
| Both crosses combined | Standard | 212 | 70.4 | 30.6 |
| | Dwarf | 40 | 72.5 | 27.5 |

TABLE IV

| | Plants | Number | Red fruited, per cent | Yellow fruited, per cent |
|---|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry | Standard | 106 | 76.4 | 23.6 |
| | Dwarf | 20 | 75.0 | 25.0 |
| 2. Yellow Cherry upon Dandy Dwarf | Standard | 106 | 74.5 | 25.5 |
| | Dwarf | 20 | 90.0 | 10.0 |
| Both crosses combined | Standard | 212 | 75.5 | 24.5 |
| | Dwarf | 40 | 82.5 | 17.5 |

TABLE V

| Parents and direction of cross | Plants | | Foliage | | Leaves | | Fruit | |
|---|---|---|---|---|---|---|---|---|
| | Standard | Dwarf | Green | Yellow | Fine | Coarse | Red | Yellow |
| 1. Dandy Dwarf upon Yellow Cherry | 84.1 | 15.9 | 79.8 | 20.2 | 77.4 | 22.2 | 75.7 | 24.3 |
| 2. Yellow Cherry upon Dandy Dwarf | 84.1 | 15.9 | 73.1 | 26.9 | 69.5 | 30.5 | 82.3 | 17.7 |

TABLE VI

| | Number of plants | Fruit | | |
|---|---|---|---|---|
| | | Weight | Length | Width |
| | | *Gr.* | *Mm.* | *Mm.* |
| 1. Dandy Dwarf upon Yellow Cherry | 126 | 13.19 | 23.13 | 29.49 |
| 2. Yellow Cherry upon Dandy Dwarf | 126 | 12.34 | 22.30 | 28.42 |

excess of the theoretical ratio and there is no difference in this respect between the two sets of $F_2$ plants. The only other wide deviation from the theoretical requirement is in the excess of plants with coarse foliage, and particularly in the second cross, where the ratio is near to two to one.

The standard and dwarf plants are associated with the two types of foliage as shown (Table II).

Table II shows that the ratios for type of foliage are quite close to the theoretical per cent when both crosses are computed together, for the dwarfs it being fully attained; but the results are markedly different from this when considered separately. The percentage of plants with green foliage is very high for the first cross, and here the seed parent is the Yellow Cherry with its green foliage. On the other hand, in the reciprocal the percentage of the plants with green foliage falls to 65, and here the seed parent is the Dandy Dwarf, which has yellow foliage.

The standard and dwarf plants are associated with the two types of leaves as shown (Table III).

Table III shows that the ratios for type of leaves are not far from the theoretical percentages when both crosses are computed together, but the results are quite otherwise when the crosses are considered separately. The percentage of dwarf plants with coarse leaves is very low when the seed parent is the Yellow Cherry, and contrariwise correspondingly high when the Dandy Dwarf is the seed parent.

The standard and dwarf plants are associated with the two types of fruit colors as shown in Table IV.

Table IV shows that the ratios for fruit colors are close to the theoretical, excepting among the dwarf plants in cross (2) in which the plants with red fruits make up 90% and the Dandy Dwarf (red fruited) is the seed parent.

A summary of the last three tables is shown in Table V.

Table V shows that in cross one (1) the green foliage and fine leaves are in excess of the theoretical percentages, while the yellow fruited plants are very close to the number called for by the Mendelian rule. In other words, the cross with Yellow Cherry as the seed parent shows in the offspring the Mendelian characters of this parent in percentages generally in excess of the theoretical number. Contrariwise the reciprocal cross (2) shows the characters of its seed parent, the Dandy Dwarf, in

numbers that are in excess of the requirements of theory. In short, the results suggest that the seed parent in both directions of the cross may have a more potent influence than its mate.

We now pass to a consideration of the fruit characters other than color namely, the weight, length and width.

Table VI shows that fruits are heavier and larger in the cross with Dandy Dwarf upon Yellow Cherry, than its reciprocal. In other words, the pollen parent is apparently the more potent for the fruit characters here under consideration.

The relation of the size of the plant (standard or dwarf) to the weight, length and width of the fruits is shown below (Table VII).

Table VII shows that when the fruits, five each, of all the 252 plants are combined, the average weight of those produced by standard plants is much less than is the average weight of the fruits borne by the dwarf plants. A similar association obtains with size of fruit, but the differences for length and width are less, namely 8.70% for length and 4.82% for width.

The relation of the color of the foliage (green or yellow) to the weight and size of the fruits is shown in Table VIII.

Table VIII shows that the plants with green foliage produced heavier fruits, than did the plants with yellow foliage, the difference being 3.87%. In length of fruit the corresponding difference is 4.69%, but in width there is no marked difference.

The relation of the type of leaf (fine and coarse) to the weight and size of the fruits is shown in Table IX.

Table IX shows that the plants with coarse leaves produced heavier and larger fruits than did the plants with fine leaves. In weight the difference

TABLE VII

| | *Plant* | *Weight, Gr.* | *Length, Mm.* | *Width, Mm.* |
|---|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry.. | Standard | 12.69 | 22.83 | 29.06 |
| | Dwarf | 15.88 | 24.66 | 29.49 |
| 2. Yellow Cherry upon Dandy Dwarf.. | Standard | 12.03 | 21.97 | 27.91 |
| | Dwarf | 14.18 | 24.04 | 30.03 |
| Both reciprocals combined..... | Standard | 12.36 | 22.40 | 28.39 |
| | Dwarf | 14.53 | 24.35 | 29.78 |

TABLE VIII

| | *Foliage* | *Plants* | *Weight, Gr.* | *Length, Mm.* | *Width, Mm.* |
|---|---|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry... | Green | 96 | 13.36 | 23.43 | 29.58 |
| | Yellow | 30 | 12.62 | 22.15 | 29.22 |
| 2. Yellow Cherry upon Dandy Dwarf... | Green | 99 | 12.44 | 22.42 | 28.17 |
| | Yellow | 27 | 12.20 | 21.69 | 28.57 |
| Both reciprocals combined..... | Green | 195 | 12.90 | 22.93 | 28.88 |
| | Yellow | 57 | 12.41 | 21.92 | 28.90 |

TABLE IX

| | *Leaved* | *Plants* | *Weight, Gr.* | *Length, Mm.* | *Width, Mm.* |
|---|---|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry... | Fine | 91 | 12.91 | 22.79 | 29.26 |
| | Coarse | 35 | 13.95 | 24.01 | 30.09 |
| 2. Yellow Cherry upon Dandy Dwarf... | Fine | 85 | 11.64 | 22.03 | 27.51 |
| | Coarse | 41 | 13.88 | 22.76 | 29.89 |
| Both reciprocals combined..... | Fine | 176 | 12.28 | 22.44 | 28.39 |
| | Coarse | 76 | 13.92 | 23.39 | 29.89 |

TABLE X

| | *Fruited* | *Plants* | *Weight, Gr.* | *Length, Mm.* | *Width, Mm.* |
|---|---|---|---|---|---|
| 1. Dandy Dwarf upon Yellow Cherry... | Red | 96 | 13.42 | 23.25 | 29.69 |
| | Yellow | 30 | 12.49 | 23.06 | 28.48 |
| 2. Yellow Cherry upon Dandy Dwarf... | Red | 97 | 13.97 | 22.61 | 28.71 |
| | Yellow | 29 | 10.44 | 21.27 | 26.76 |
| Both seciprocal combined..... | Red | 193 | 13.70 | 22.88 | 29.21 |
| | Yellow | 59 | 11.47 | 22.17 | 27.80 |

is 13.43%, in length 4.23% and in width 5.28%.

The relation of the color of the fruit (red or yellow) to the size and weight of the fruit is given in Table X.

Table X shows that the plants with red fruits produced heavier and larger tomatoes than did the plants with yellow fruits, the difference in weight being 11.59% and in length and width 3.20% and 4.88% respectively.

The green foliage carries more chlorophyll than yellow foliage and therefore it may be expected to have the greater photosynthetic power; and this may account for the differences in weight and size of fruits. Excepting this single factor the series of tables shows that the Mendelian characters, associated in the Dandy Dwarf, are correlated with the larger fruit. This is in the face of the downward pull of the factor for yellow foliage.

| | *Number* | *Weight, gr.* | *Length, mm.* | *Width, mm.* |
|---|---|---|---|---|
| The extracted Yellow Cherry | 31 | 11.31 | 22.07 | 27.61 |
| The extracted Dandy Dwarf | 4 | 17.00 | 25.20 | 33.60 |

From this table it is computed that the excess of weight and size of the fruits from plants of the Dandy Dwarf type over those of the Yellow Cherry are 50.31, 14.18 and 22.48 per cent respectively.

As frequently shown in plant breeding, it is here found that the fruits of the $F_1$ plants exceed in weight and size those of the $F_2$ plants, as shown below:

| | *Weight, gr.* | *Length, mm.* | *Width, mm.* |
|---|---|---|---|
| $F_1$ | 16.38 | 27.21 | 34.41 |
| $F_2$ | 13.45 | 23.38 | 29.09 |

It might be more to the point to make the comparison with only the $F_2$ plants that show the Mendelian characters of $F_1$. There are 40 of these in one cross and 38 in its reciprocal, and the results for these 78 plants—extracted $F_1$ if one may so call them, are as follows:

| *Weight, gr.* | *Length, mm.* | *Width, mm.* |
|---|---|---|
| 12.15 | 22.57 | 28.42 |

It is seen that the differences between the $F_1$ and the $F_2$ are here greater than when all the $F_2$ plants are considered.

The present study of the $F_2$ of a true reciprocal cross of the two widely differing varieties of tomatoes suggests, that for the Mendelian characters the seed parent in both combinations shows a more potent influence over the offspring than does its mate, the pollen parent. But with characters of fruit weight and size requiring averages for an expression of results, the evidence points in the opposite direction, namely that the pollen parent is the more influential.

When the results of both crosses are combined, it is noted that the fruits of greater weight and size are produced by: (1) Dwarf plants, (2) green-foliage plants, (3) coarse-leaved plants, (4) red-fruited plants. The extracted Dandy Dwarf plants, so far as the Mendelian characters are concerned, had unusually large fruits and contrariwise the extracted Yellow Cherry plants for their segregating characters had comparatively small fruits.

---

## Proposed South African Agricultural Census

The announcement is made in *Commerce Reports* that a census is soon to be taken of all agricultural resources in the Union of South Africa. The census is to be exhaustive and will embrace live stock, cereals, dairy products, viticulture, the area of farms, the number of agricultural employees, irrigation of land, afforestation, and such matters as will be necessary to afford complete information on those subjects. Provision is to be made for the returns to show the ages and classes of stock, sheep, ostriches, poultry, horses, mules, and asses. Data on stock diseases and losses from droughts will be collected, and farm implements are to be enumerated, while at the same time all phases of wine cultivation will be classified.

# A DRY BLOOD-ORANGE STRAIN

A. D. SHAMEL, *Riverside, Cal.*

THE Ruby blood orange variety (*citrus sinensis Osbeck*), was introduced into California from Florida. The trees of this variety have been long known to produce variable fruits, but so far as known, no systematic study of these bud variations was made until those begun by the writer in the season of 1916-1917. A very productive and commercially profitable ten-acre orchard of this variety located near Corona, Cal., was selected for the purpose of carrying on individual tree and fruit studies. The trees are about twenty-four years old and are in fine physical condition. Individual tree records of production are being secured from all of the trees in this orchard, and detailed performance records made from a few select trees. It is not the purpose of the writer to describe the work at this time. It is his desire, however, to call attention to one of the many interesting cases of bud variation existing in this orchard. As a whole there has been found to be more frequent instances of striking bud variations in the trees of this variety than in those of any other citrus variety studied thus far.

### SPORT ATTRACTED ATTENTION

During the first tree census observations in the Ruby blood orchard, amongst the very many variable fruits discovered, one in particular has made a lasting impression in the mind of the writer, his associates, and the visitors to this interesting orchard. It was first discovered as a large limb sport in a typical Ruby blood tree. This large limb protruding from near the top of the tree attracted attention because of a different appearance in foliage characteristics from that of the remainder of the tree. In part, this difference was caused by the narrower and more lanceolate shaped leaves than is characteristic of the normal Ruby blood leaves. The branches of this limb also possessed a somewhat different habit of growth than that of the branches on other limbs of this tree. The fruits borne by the limb sport did not appear, at first glance, to be particularly different in general appearance from the ordinary Ruby blood oranges.

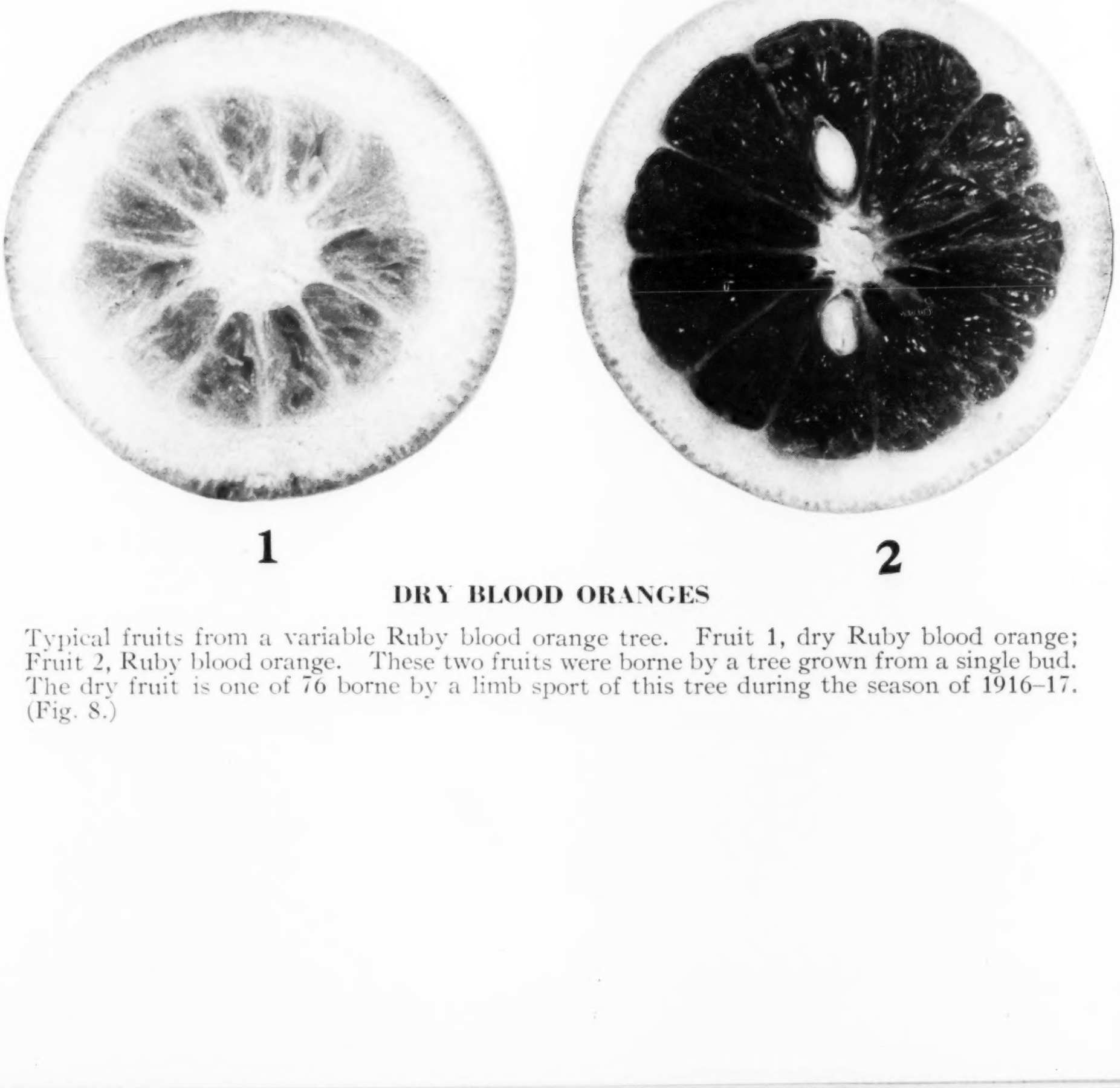
### AN ENTIRELY DRY ORANGE.

When one of the limb-sport fruits was cut open, very striking differences were found from the characteristics of the normal Ruby blood orange. The rind was found to be very thick, about double that of the normal fruits. Instead of having a rich blood-like color, the fruit from the limb-sport was straw-colored. Instead of bursting with an abundance of juice, as was the case with normal fruits borne by other limbs on this tree, there was no juice in this fruit. Strenuous efforts to squeeze out even a little juice failed to find a single drop. In other words it was a dry orange.

All of the fruits, seventy-six in number, borne by this limb were cut. Except in the case of five fruits, where one or a few cells contained blood red juice, all of them proved to be similar to the first one cut. An example of the dry orange from this limb in comparison with a normal Ruby blood fruit from this tree is shown in Fig. 8. While the color differences cannot be adequately shown by a photograph some idea of the differences in color, thickness of rind, character of rag and other characteristics can be seen in this illustration.

Further studies of the trees in this orchard revealed the fact that there existed many limb sports bearing dry oranges. About one hundred such limbs were found in the preliminary study of the orchard. In some cases the limbs were large and bore many dry fruits. In other instances the limbs were small and bore only a few dry

1



2

**DRY BLOOD ORANGES**

Typical fruits from a variable Ruby blood orange tree. Fruit 1, dry Ruby blood orange; Fruit 2, Ruby blood orange. These two fruits were borne by a tree grown from a single bud. The dry fruit is one of 76 borne by a limb sport of this tree during the season of 1916–17. (Fig. 8.)

**A DRY BLOOD ORANGE TREE**

A close-up view of a section of a dry Ruby blood orange tree showing cross-sections of a typical dry Ruby blood orange. (Fig. 9.)

fruits. Occasionally normal Ruby blood oranges were found on the limbs bearing dry fruits. In some other cases certain sections or cells in the dry fruits contained normal Ruby blood juice.

ENTIRE TREES BEAR DRY FRUITS.

While studying the limb sports bearing dry oranges, the discovery was made that several entire trees in this orchard bore dry fruits. Some of these trees were fairly prolific, bearing several boxes of fruits each. Heretofore, these dry fruits, from the limb sports and from the entire trees, had been included in the regular pick and pack from the orchard, owing to the lack of knowledge concerning the characteristics of the dry fruits. No doubt the consumers who found these fruits in their purchases were disappointed. Since the discovery of the dry limb and tree strain, all of the limbs and trees bearing dry fruits, except those reserved for experimental study, have been pruned out by the owner of the orchard. Hereafter, the dry fruits will not be commonly found in the pack from this orchard.

In most of the trees bearing dry oranges, one or more small branches were found bearing normal Ruby blood fruits, and in some cases other types of blood oranges. Occasionally, single Ruby blood oranges were found in the dry trees, as well as other variable fruits. Also in normal Ruby blood trees, single dry fruits or small branches bearing several dry oranges, were frequently found by the writer and his associates.

DRY ORANGE SPORT DANGEROUS.

Summing up our observations on the dry Ruby blood orange strain in the orchard where these studies are being carried on; entire trees, large and small limb sports bearing dry fruits and individual dry oranges, were found to be of frequent occurrence. In the dry Ruby blood trees and limbs, normal juicy Ruby blood oranges were found occasionally. The dry Ruby blood orange strain is a bud variation of the Ruby blood variety, and commercially is not only worthless but dangerous to the reputation of the crops from orchards containing these dry fruit sports. Until recently the dry fruits have usually been included in the regular pack from the orchard. Now the dry limb and tree variations, except those reserved for further study, have been eliminated in the orchard under observation.

---

## A New Eugenics Organization Founded in Brazil

Expressing a desire that their country should not lag behind the march of science, the medical fraternity of São Paulo, Brazil, has founded a society devoted to the physical and moral improvement of the human race, which is known as the *Sociedade Eugenica de São Paulo*. The inaugural meeting was held under the auspices of the Society of Medicine and Surgery and was attended by a large and enthusiastic audience, says the *Corrcio Paulistano*.

After speeches explaining the plans of the eugenists by Dr. Renato Kehl and Dr. Olegario de Moura, election of officers was held. The following were elected:

Honorary presidents, Dr. Augustino José de Sousa Lima and Dr. Amancio de Carvalho; president, Dr. Arnaldo Vieira de Carvalho; vice-president, Dr. Olegario de Moura; secretary, Dr. Renato Kehl; vice-secretaries, Dr. Th. de Alvarenga and Dr. Xavier da Silverira; treasurer, Dr. Argemiro Siqueira.

# PIGMENTATION IN GUINEA-PIG HAIR

## Microscopical as Well as Chemical Studies Reveal Many Differences Between the Black and Red Colors—Genetic Investigation Reveals but a Single Difference—the Problem is Suggested of Explaining the Many Observed Differences as Results of a Single Fundamental Physiological Difference

HARRISON R. HUNT, *West Virginia University*

AND

SEWALL WRIGHT, *Bureau of Animal Industry, Washington, D. C.*

IN RECENT years many interesting facts have been discovered concerning the inheritance of coat color in guinea-pigs. It seems to the writers that the time is now ripe to correlate these facts of heredity with the color, form, and chemical constitution of the pigments which impart the color to the different forms of guinea-pig hair. Progress in science is frequently made by attacking a problem from a new angle. Such a correlation as the one just mentioned should throw some light on the physiology of pigment formation in mammals.

In all, twenty-eight samples of guinea-pig hair have been studied so far. These were dehydrated in absolute alcohol, cleared in xylol, imbedded in paraffin, sectioned and mounted in the usual way, and studied, unstained, with the oil immersion.

The cortical, or peripheral, and the medullary, or central, regions of the guinea-pig's hair present characteristic differences. The medulla contains extensive communicating air spaces (see figures), and its substance stains readily with eosin. The cortical material lacks this reaction with eosin and air spaces are entirely absent. The cuticle forms a thin outer covering for the hair

The color of the hair depends upon two forms of pigment—diffuse and granular. The former lends color to the hair in much the same way that substances in solution may color a solvent. The adjective "granular" sufficiently explains the character of the other kind of pigment.

The color and the distribution of these pigment substances in the medulla and cortex demonstrate some interesting facts in the physiology of pigment formation.

### OBSERVATIONS

*Black Hair.*—The most noteworthy fact in the case of black hair is that both the medulla and the cortex have an abundance of black granular pigment. (Fig. 10.) The cortical granules are short cylindrical rods whose diameters are, roughly, half or two-thirds their length. The average length is about 0.8 of a micron. Their long axes lie lengthwise of the hair. The medullary granules vary in size and shape, the smallest ones being about 0.2 of a micron in diameter and the largest approximately 3½ micra in their greatest dimension.

In the same samples of hair, the granules are often more closely aggregated in cross-sections of small diameter than in larger sections. The smaller cross-sections were probably cut nearer than the larger ones to the distal ends of the hair. Since the tips of the hairs are usually darker in color than the bases, one would expect to find the condition just described—more granules near the tips.

*Sepia Hair.*—In sepia hair the granules are black. They vary considerably in size and are abundant in both cortex and medulla. The cortical granules as in black hair are predominantly short bacillus-like rods, oriented with their long axes parallel to the long axis of the hair. The distribution and

the number of the granules observed in sepia hair seems to be practically the same as in black hair. However, since black hair is darker than sepia, it certainly must contain a slightly larger amount of black pigment than sepia hair.

*Red Hair.*—Red hair, like black and sepia, has a large amount of granular pigment in the medulla, but unlike them it has *very few* granules in the cortex. As will appear later, this absence of cortical granules is a significant fact.

The granules in red hair vary widely in size and shape. Nearly all are spherical, having a diameter, as accurately as could be computed, of 0.2 to 0.3 micron. It is difficult to see these small ones clearly except when an oil immersion objective is used. The largest granules, which are relatively few in number, are elongated. Some of them are as large as 6 micra x 2 micra, about eighteen times as long as the smallest particles. Between these two extremes is found a great variety of intermediate sizes.

The color of the pigment particles is distinctly yellowish. The difference in color between them and the pigment in black hair is very clearly seen when one compares sections of the two kinds of hair under the same conditions of illumination and magnification.

Diffuse yellowish pigment is abundant in the cortex of some hairs. Probably it is present in every hair but can be seen only in those sections where it is relatively concentrated. It is most dense around the medulla, fading away to invisibility near the surface of the hair.

*Yellow Hair.*—The number of granules in the cortex of yellow hair is extremely small. The medulla contains a greater quantity of granular pigment, but even this is considerably less than in the medulla of red hair. Comparing red with yellow guinea pigs, one finds that the yellow color is really a dilute red. The difference in the quantity of granular pigment observed in the hair sections may explain this color dilution.

The granules in the yellow hair vary markedly in size and color. There are a few of the large yellow type such as are found in red hair. Of the smaller granules, a large part seem to be as *black* as the smaller ones in black hair, while the rest are yellowish. Probably these black granules are more highly oxidized melanin than the yellow ones. Yellow hair is sometimes slightly sooty in appearance. The black granules are undoubtedly responsible for this sootiness.

A slightly yellowish tint in the cortex of a few hairs suggests that diffuse yellow pigment may be present, but is not always visible on account of the thinness of the sections.

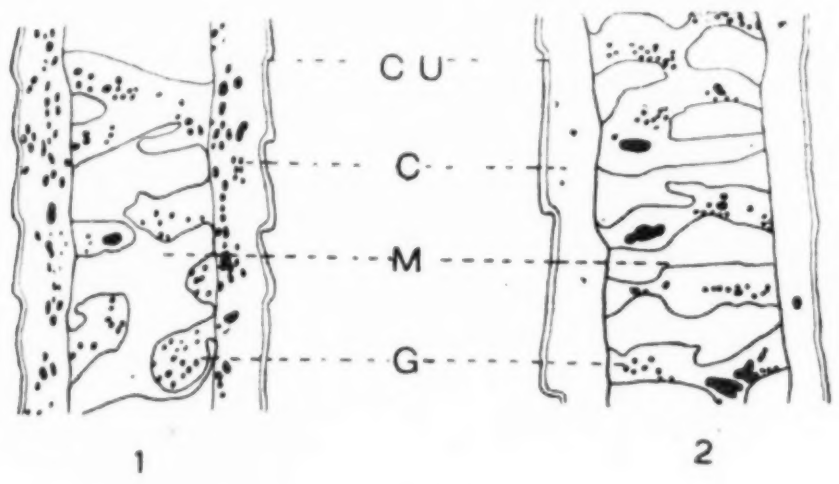
*Cream Hair.*—The medulla and cortex of cream hair contain a very few granules, apparently black, of approximately the size of the granules in red hair. The sections do not furnish evidence of diffuse pigment, but the dark color and the small number of the pigment granules can hardly account for the color of the hair, which is not black but cream. Therefore diffuse yellow pigment is probably present, but in such small quantities that in the sections it does not visibly alter the color of transmitted light.

## DISCUSSION OF OBSERVATIONS

The preceding discussion has brought out a number of distinct ways in which red hair differs from black. First, there are differences in the character of the pigment. Black hair contains only granules and these are dark in color. Red hair contains both granules and diffuse pigment, and these are light colored. There is a difference in distribution; in black hair, granules are abundant in both cortex and medulla, while in red hair they are found almost exclusively in the medulla.

Next there is a difference in the effect produced when the same genetic factors are introduced into black and red stocks of guinea pigs. The case of most interest here is the effect of introducing grades of albinism. Complete albinism reduces both black and red to white. the dilution factor, an allelomorph of albinism, when introduced into black stock, produces sepia, a dark brown color, which grades into black. No

certain distinction could be observed under the microscope between samples of sepia and of black. When the same dilution factor is introduced into reds, the color is changed to yellow or cream, and the sections show a marked reduction in the number of granules as compared with red hair. With a still lower grade of imperfect albinism, red is wholly reduced to white, while black is still only very slightly affected. This greater susceptibility of red to the influence of dilution factors is the rule among mammals.




**MAGNIFIED HAIRS**

Longitudinal sections of guinea-pig hairs magnified 1550 diameters.

Fig. 1, Black hair; Fig. 2, red hair; Fig. 3, yellow hair; Fig. 4, cream hair; CU, cuticle; C, cortex; M, medulla; G, pigment granule. (Fig. 10.)

To these differences between black and red may be added certain ones observed by other workers. Miss Durham[1] found a distinct difference in solubility of the pigments. Dilute alkali dissolved red pigment easily but black hardly at all. Gortner[2] observed a pronounced chemical difference. Black pigment from several sources contained considerable iron, while red pigment contained virtually none. Onslow[3] discovered a difference in the enzyme content of the skins of black and yellow rabbits. He could extract a peroxidase from the skins of black rabbits but not from yellow. With this peroxidase he could produce dark pigment resembling melanin.

At first sight it seems necessary to suppose that black and red guinea pigs differ from each other by many physiological factors in order to account for these many differences. But there is probably only one primary physiological difference between black and red hair, because a single genetic factor is enough to effect the change. All the observed differences are, in some way, direct or indirect effects of this primary dfference.

It is generally agreed that melanin pigment is produced by the oxidation, through the influence of oxidizing enzymes, of protein metabolic products such as tyrosin. The simplest explanation of the difference between black and red hair seems to be that a certain specific enzyme (enzyme II), which is present in black, is absent in red. This enzyme increases the oxidizing power of another, more fundamental, enzyme (enzyme I) whose presence is necessary for the production of *any* pigment. (Wright.)[4] The more thorough oxidation of the chromogens in the case of blacks is probably responsible for the differences in color between black and red hairs, the more thoroughly granular nature, and the decreased solubility of black pigment.

The difference in iron content, noted by Gortner, seems at first to indicate a specific difference in the chromogens of blacks and reds, as well as in the enzymes producing them. But the following explanation is possible. The chromogens oxidized in the red hair are also oxidized in black, but in addition iron-containing chromogens are oxidized in the latter.

The presence of granular pigment in

[1] Durham, F. M., 1904. *Proc. Roy. Soc London.*, 74:310–313.
[2] Gortner, R. A., 1911. *Biochem. Bull.*, 1:207–215. 1912. *Proc. Soc. Exp. Biol. and Med.*, 9:3–4.
[3] Onslow, H., 1915. *Proc. Roy. Soc.*, B–°9:36–58.
[4] Wright, S., 1917. Jour. Heredity, 8:224-235.

the cortex of black and sepia hair and its almost complete absence in red and yellow, shows that the constitution of the cortex imposes some obstacle in the way of cortical pigment production in red and yellow hair. The enzyme for black overcomes this obstacle; therefore pigment appears in the cortex of black and sepia hair. It seems likely that this obstacle is the slowing up of the oxidation of chromogens in the cortex. This inhibiting action of the cortex is similar to the effect which the dilution factors have upon pigment production. The dilution factors reduce very little the quantity of pigment in black hair, but considerably diminish the amount in red. *Thus it seems plausible that there is some characteristic peculiarity of the cortex of guinea-pig hair which diminishes the quantity of cortical granular pigment in much the same way as the dilution factors reduce the total granular pigment content.*

---

## Budding Incompatible Cottons.

An experiment has come to light in the field notes of the late R. M. Meade which should be of interest to plant breeders. Mr. Meade has been trying for several years to secure hybrids between American Upland cotton, *Gossypium hirsuum*, and two Asiatic species, *G. herbaceum* and *G. indicum*. From the standpoint of fertile seeds these attempts proved to be unsuccessful but in many instances the cross-pollinated fruits remained on the plants for several days longer than those not pollinated, indicating that initial growth had been stimulated by the application of foreign pollen.

That growth was started seemed to mean that fertilization might have taken place and that complete development was prevented by some form of chemical incompatibility that caused the shedding of the young bolls. Mr. Meade ingeniously planned to overcome this obstacle by budding one species upon the other with the idea that the sap of the stock would exert an influence upon the chemical composition of the floral organs of the budwood. No difficulties were encountered in getting buds of American Upland varieties to grow on Asiatic stock and vice versa and several successfully budded plants were secured. Unfortunately the plants were budded so late in the season that only one of the resulting branches produced flowers and this at a time when no flowers were open on the stock plant.

That the sap of the stock may alter the chemical composition of the budded branches was shown by an experiment in budding two distinct Upland varieties. The variety used for budwood was Willet's Red Leaf. This variety has dark red foliage and stems, which are very distinct in color from those of normal green varieties. The stock was a normal green variety called Trice. Several buds of the Willets's Red Leaf were inserted on the Trice stock; these buds developed rapidly, producing large well-formed leaves and branches. The first leaves on the young budded branches were red in color like the plant from which the bud came but the succeeding leaves became lighter and lighter in shade until at the end of the season they were only half as dark as those of the parental plant which were all dark red. This fact certainly seems to support Mr. Meade's hypothesis that the chemical composition of budded branches might be influenced through the stock, and leaves open the possibility of accomplishing the hybridization of American Upland and Asiatic species of cotton.

A more adequate investigation of this interesting phenomenon is highly desirable. It is hoped that this method of overcoming cross sterility, the testing of which was interrupted by Mr. Meade's untimely death, may be of interest to other investigators.

# SOME OBSERVATIONS ON MONKEYS

## Striking Affinities Apparent Between Homo and Simia, Both Mentally and Morphologically—Although Certain Differences Hold Good in the Mean, Abnormal Specimens of Homo May be Found Who Show Many Supposed Criterion of Simianism

DR. R. W. SHUFELDT, C. M. Z. S., *Washington, D. C.*

AMONG the many interesting books of the late Prof. St. George Mivart stands the very excellent little volume "Lessons in Elementary Anatomy," which appeared in 1877, and which is a most useful treatise, carrying many instructive illustrations. At the close of this work Professor Mivart says: "Having now completed our elementary investigation and exposition of the various organs and parts which make up man's body, and having noted the more important differences which the corresponding structures may present in other vertebrate animals, it may be well, shortly, to recapitulate some of the leading distinctions in a different sequence and arrangement, in order to bring out more clearly not only the peculiarities, but also the affinities evidenced by various anatomical relations between the body of man and those of other vertebrates."

The results throughout anatomical literature along this line of inquiry and comparison, will stand for the advantage man has reaped, in all ages, from just such investigations, when they have been correctly and intelligently made and employed. Mivart, in the little work above mentioned, first contrasted many of the points in the skeleton of man with what we find in fishes. In a similar manner comparisons were made with the salient points in the anatomy of the batrachians, the reptiles, the birds, the monotremes, the marsupials, and the mammals; finally, his last table sets forth how man differs from all members of his order, except the three highest genera, the orang (*Simia*), the gorilla and chimpanzee (*Troglodytes*), and the gibbon (*Hylobates*)—that is, with respect to his anatomy. In this he enters more extensively than into the other comparisons he makes; there are thirty-five points recorded in the list, wherein man differs from the highest apes, and five wherein he differs from all members of his order.

### MANY POINTS CONTRADICTED

These comparisons I have gone carefully over many times, not infrequently with the actual material at hand. From these perusals I am convinced that Mivart must have compared only such osteological and other characters as occur in the skeleton and general organization of the very highest types of men with such corresponding ones as had been brought to light in the simians during the time he wrote and before—or about half a century ago. As a matter of fact, among the very lowest races of men—and in abnormal specimens—we meet with examples which will contradict nearly every point Mivart attempts to make in the final tabulation referred to above. If we confine ourselves to the skull alone, it will be seen that this is true. I was convinced of this about a year ago, when I carefully examined and compared some 20,000 human skulls, of all races, in the collection of the United States National Museum at Washington.[1] To refer to a few of these, I may

[1] This comparison forms the basis of an extensive memoir, with many photographic and line-drawing illustrations, which has been accepted for publication by the Medical Department of the Army.

**A MACAQUE MONKEY**

Especially worthy of note is the form of the ear in this specimen, since it is pointed posteriorly. In rare cases in man a point of the ear may be found turned in. (Fig. 11.)

say that it is not true that "the cranio-facial angle varies from 90° to 120°," nor that the "superciliary ridges are little developed;" neither is "a long styloid process" always present in the skulls of *Homo*.

As a matter of fact, while the characters referred to by Mivart as exemplifying the anatomical organization of man, contrasted with that of the simians or apes, are generally to be found in the higher races of men—more particularly the highest races—they are frequently absent in lower ones, as for instance among negroes, native Australians, and the like, where we meet with examples that are quite ape-like in some parts of their anatomical organization. As for that, I have examined negro skulls wherein the jaws were very large and powerful; the nasal spine almost aborted; the superciliary ridges prominently developed; the maxillo-premaxillary suture present in the adult; the cranio-facial angle very small, and so on through the category. These characters, as found in the skulls of negroes, are fully set forth in my recent work on "The American Negro," and in numerous articles on the subject, published during the past thirty-five years.

### ANTHROPOIDEA DIFFER WIDELY

Anatomically, the *Anthropoidea* differ widely among themselves—that is, the higher apes, the monkeys, gibbons, and marmosets; this is also true of many races of men. This is quite apart from their anatomy or physical organization; for in that matter the morphology of the lowest form of monkey is quite as complex as that of the highest type of man. To be sure, the brain of the latter possesses the greater number of convolutions, and there are other structural differences; but, part for part, the organization of the one is reproduced in the other. Some structures may be

**A SOUTH AMERICAN TYPE**

Head of a black spider monkey (*Ateles paniscus*); en face. Adult male. (FIG. 12.)

**ONE OF THE SMALLER APES**

Same specimen as shown in Fig. 12 seen on right profile. (Fig. 13.)

**HAND AND FOOT OF ATELES**

Palmar aspect of left hand of Black Spider Monkey shown in right-hand cut, with aborted thumb. The left-hand cut shows the right foot of the same individual. This graphically resembles a human hand. The great toe, which is well developed, has the appearance of a finger, and the palmar surface extends backwards more than might be anticipated. The nails resemble greatly those of the human hand. Photograph natural size. (Fig. 14).

missing in man's anatomy, and present in the ape's; but this in no way contradicts the aforesaid statement. So, too, for the organs themselves as a whole—the eye, or the ear, or the tongue of a monkey is just as perfect and complex as are the corresponding organs in man.

Elliot, in his great work (three volumes) on "A Review of the Primates," says: "In this review the orangoutang is placed lowest in the scale or farthest from man; and the genus Pongo is considered to possess but one species certainly, and one very doubtful. The author is fully aware that this opinion is by no means shared by some of his colleagues, who would recognize a large number of species; but after examining all the material of orangs contained in all of the large museums of the world, the writer was able to discover no character that would prove the existence of more than one species. The opinions as to the position the orang should occupy in reference to man have varied greatly, yet despite the views of so great an authority as that of his friend, the late Sir Richard Owen, who would place the orang before the gorilla in its relation to man, the author, from the result of his own studies and the evidence produced by others, considers that the testimony in its entirety shows that the gorilla, low as he may be in the scale of intelligence, has more of an affinity for man than the orang, while both are far exceeded in man-like qualities by the chimpanzee." (Vol. i, p. xxvii.)

Passing next to a brief consideration of the mental and physical attributes of apes, monkeys, and their various near congeners, as compared with the corresponding ones in man, I may truthfully state that simply tons of books and articles have been published on that subject. Notwithstanding this fact, how very, very few there are, even in the highly intellectual classes, that can intelligently discuss the mental and physical differences that exist between man and the apes and their near kin. As a matter of fact, articulate speech, as possessed by the former, is the main distinctive character between them. Even this distinction is not wholly true, for all apes and all monkeys have a language of their own, which has been largely translated by students of it. As to the emotions, apes possess them as well as man, and, with respect to some of them quite as pronounced. There is no question but that all the *senses* are as well developed in apes as in man, as sight, hearing, smell, and so on.

Long ago, Professor Huxley said that "a man born dumb, notwithstanding his great cerebral mass and his inheritance of strong intellectual instincts, would be capable of few higher intellectual manifestations than an Orang or a Chimpanzee, if he were confined to the society of a few dumb associates. And yet there might not be the slightest discernible difference between his brain and that of a highly intelligent and cultivated person. The dumbness might be the result of a defective structure of the mouth, or of the tongue, or a mere defective innervation of these parts; or it might result from congenital deafness, caused by some minute defect of the internal ear, which only a careful anatomist could discover.

"The argument, that because there is an immense difference between a man's intelligence and an ape's, therefore there must be an equaliy immense difference between their brains, appears to me to be as well based as the reasoning by which one should endeavor to prove that, because there is a 'great gulf' between a watch that keeps accurate time and another that will not go at all, there is therefore a great structural hiatus between the two watches. A hair in the balance-wheel, a little rust on a pinion, a bend in a tooth of the escapement, a something so slight that only the practiced eye of the watchmaker can discover it, may be the source of all the difference."

**ATELES' FIFTH HAND**

Some monkeys are afforded practically an additional hand by a prehensile tail such as this. Although it is not used for tactile examination of objects, for purposes of locomotion it serves as well as any other member. However, it is probable that such an equipment is genetically inferior to the two hands and two feet supplied man. (Fig. 15.)

Through the kindness of Mr. Edward S. Schmid, of Washington, D. C., who presented me with the material, I am enabled to offer, as illustrations to the present article, various reproductions of photographs which I have made of two species of monkeys, and which aim to show facial expressions as well as the morphology of hands, feet, and tail. In Fig. 11 we have the portrait of the common Macaque monkey of India (*Macacus rhesus*), a form which stands between the African mangabeys and the baboons. Special attention is invited to the form of its ear and its general physiognomy. Note that the ear is *pointed* posteriorly. In the human species we sometimes meet with cases where this point is present and turned down. Darwin gives an excellent account of this structure in his work on "The Descent of Man" (pp. 15–17), and I have personally seen some excellent examples of it, the best one being in the case of a very low, black negro in New Orleans. This point is not present in the ears of all apes and monkeys, among others it is absent in the large, black spider monkey (*Ateles paniscus*), here shown in Figs. 12 and 13. In the foetal Orang it is directed upward.

In passing I may say that the black spider monkey belongs in a group wherein the tail is prehensile, and to a large extent fulfills the function of a fifth hand. Its form is well shown in Fig. 15, and this structure, as well as the hand and foot portrayed in Fig. 14, all belonged to the black spider monkey mentioned above (Figs. 12 and 13). This species gets its name, *Ateles*, from the fact that it possesses no thumb, that digit of the hand having, in time, entirely aborted. (Right hand cut of Fig. 14.) The lines of the palmar surfaces of the hands and feet in monkeys is an interesting field for comparative study, but up to the present time but little has been published on the subject.

# PENETRATION OF SCION BY STOCK

G. B. Patvardhan
*Assistant Professor of Botany, Agricultural College, Poona, India*

DURING a casual observation of a few rose plants growing in my compound, in the month of August, 1917, I happened to notice one budded plant with 5 shoots emanating from the region where the original bud was inserted on the stock. The scion is a *Paul Neron* rose. The plant was originally grown in the Ganeshkhind Botanical Gardens, Kirkee, India. The bud was inserted on a one-year-old stock about the month of February, 1916. The scion was pruned once about the month of April, 1917. On a very careful examination of the five shoots, it was found that the center one, which was older, thicker and riper than the rest, was the original scion and three of the remaining four were shoots which clearly showed the characters of Edward rose. Two of these shoots 2, and 3, when I first noticed them, showed one flower each, which was undoubtedly our common Edward rose, while the center one, about a week later, showed a bud which was quite similar to that of a *Paul Neron*. It is regrettable that the fully expanded flower from this bud was, however, pilfered away by somebody before the flower could be observed by me. The plant was taken to the Agricultural College and shown to Dr. Burns, Economic Botanist to the Government of Bombay, before photographing, which was done on September 8, 1917, just before the bud appeared. The flowers of the Edward rose dropped their petals during transit to the college for photographing.

### ORIGIN OF SHOOTS PROBLEMATICAL

The question of interest is—how did four shoots of the stock appear from the budwood of the scion? Usually vigorous outgrowths from the stock appear below the point of insertion of the scion and these are usually rubbed away, so that any depletion of the supply of sap to the scion is prevented and all that is sucked up by the stock, is available for the use of the scion. In this case the shoots of the Edward rose are about 9 or 10 weeks old (by August-September, 1917). They seem to be derived from adventitious buds which might have appeared on the stock below the budwood, even after latter had become well established and forced their way through the tissue of the scion. An examination of the photograph shows that the shoots have clearly originated from the budwood within the area of the callus formed at the margin of the slit made for budding, and not from any doubtful region such as the margin of the slit or elsewhere closer.

I am adding the following after observing the plant for a month and a half since noting the above. Shoots Nos. 2 and 3 flowered again on October 25, 1917. The flowers were Edward roses. This confirms previous statement regarding shoots Nos. 2 and 3. Shoot No. 1 has grown very long and vigorously. It is expected to flower in the next few days and confirm its nature.

From the comparative vigor of growth, I conclude that Nos. 1, 2 and 3 are shoots of Edward roses derived from the stock and No. 4 is *Paul Neron*, which has made no further growth since first photographing. Similarly No. 5 also has made no further growth, both being held in check by the superior power of Edward shoots of drawing or sucking up more sap than could be done by the scion from the stock.

**AN UNUSUAL BUD FREAK**

The budded region of the plant showing the positions and origin of shoots. The shoots 1, 2 and 3 belong to the Edward Rose variety and 5 is the scion. The swollen and projecting portion is the original budwood. The raised edge of the bark of the stock is shown by 6. (Fig. 16.)

# STRIKING ORANGE BUD VARIATIONS

A. D. SHAMEL, *Riverside, Cal.*

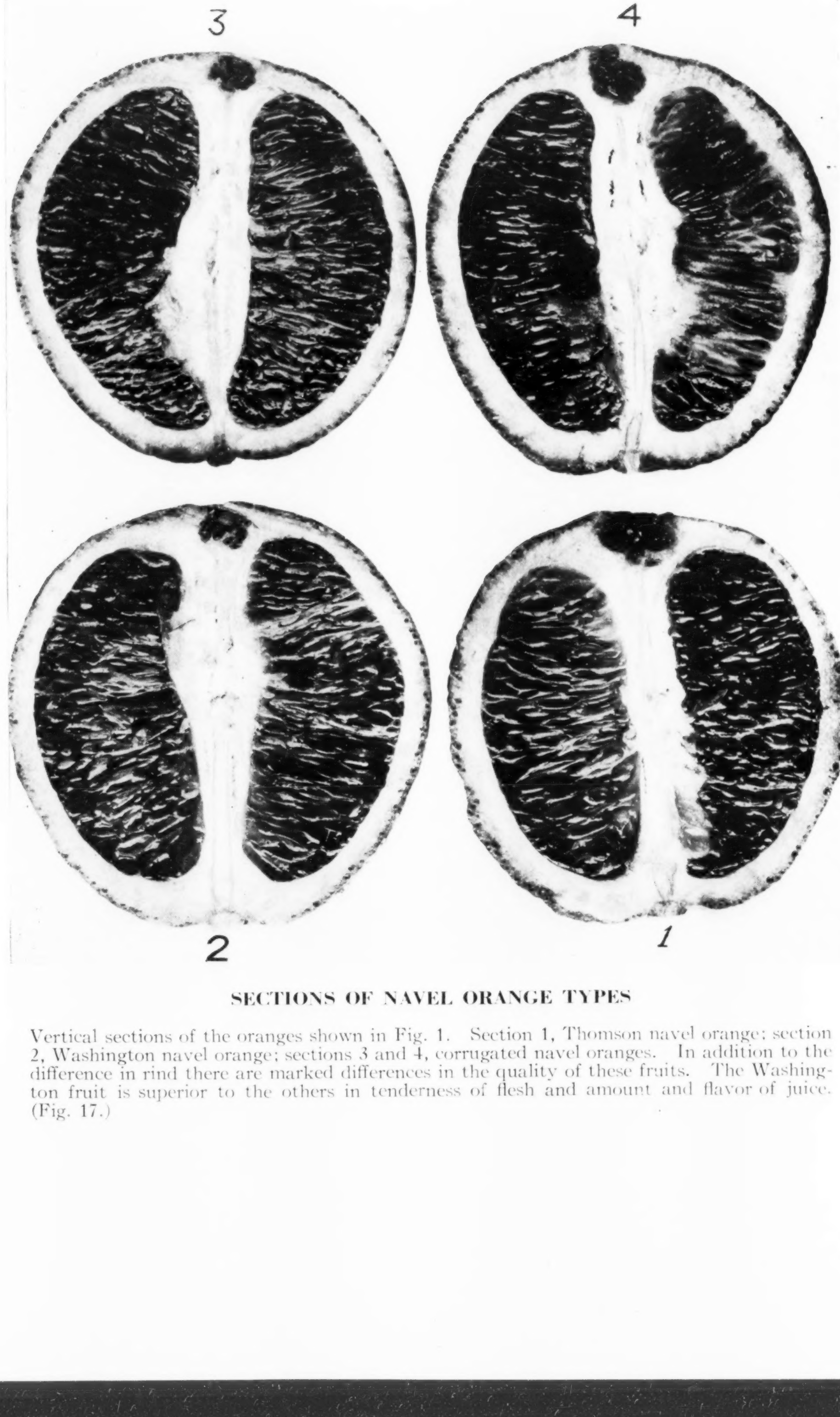
A "THOMSON strain" tree of the Washington navel orange variety in one of the individual tree performance record plats on the Eureka ranch near Riverside, Cal., has for eight years consistently produced striking bud variations. Typical fruits of two of these variations and one of the typical Thomson oranges are shown in the accompanying illustrations. It has been discovered that the Thomson strain is a bud variation of the Washington navel variety. The Washington fruits, borne by a limb in this Thomson tree, may be considered in the nature of reversions to the parent variety. One of the large limbs bears the corrugated fruits. In this limb occasional Washington and Thomson fruits have been found from time to time.

Propagations of buds secured from fruit-bearing budwood were made from the Washington limb, the limb with the corrugated fruits, and the Thomson limbs, in the spring of 1913. The trees from these propagations came into fruiting for the first time this season, 1917-1918. The young trees have uniformly borne fruits similar to that borne by the parent limbs and the budwood from which they were propagated. In other words three strains have been isolated from the parent tree through bud selection, viz., Washington, Corrugated, and Thomson.

There are certain foliage characteristics of these strains which have been reproduced in the young trees. The young trees of each of these strains have characteristic habits of growth similar to that of mature or full-bearing trees of these strains.

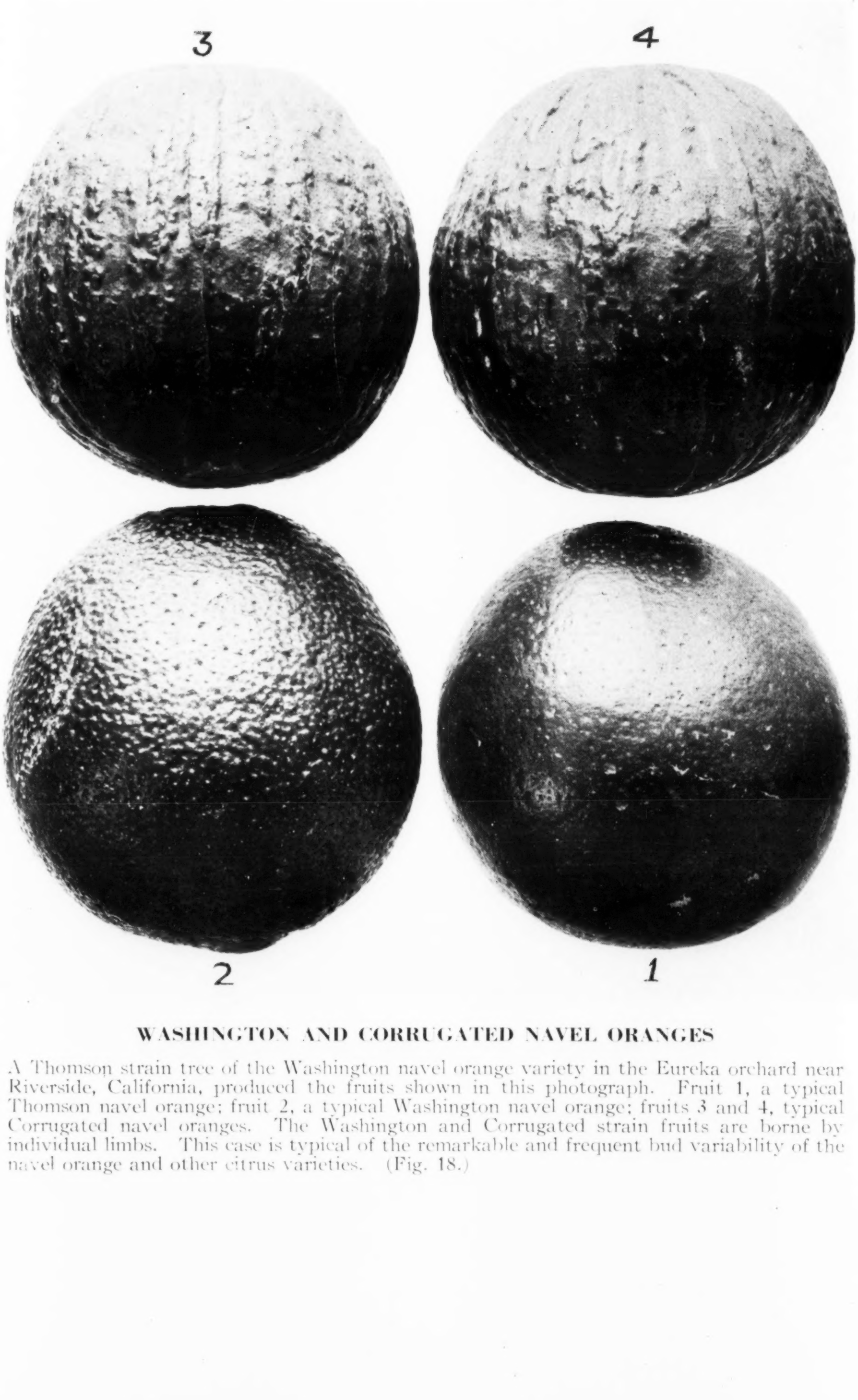
### DIFFERENCES OF IMPORTANCE

The very important commercial differences in the value of the fruits of these strains can be easily seen from the photograph of the typical fruits. The differences in rag, juiciness and quality of the juice of these fruits is not so easily shown or described. The Washington fruits have a tender rag, melting in the mouth, an abundance of juice which possesses the rich and high flavor characteristic of the fruits of this variety. The Thomson fruits have a woody or tough rag, are lacking somewhat in juice, and the flavor of the juice is inferior to that of the Washington fruits. The Corrugated fruits have a tender rag, very similar to that of the Washington fruits, but the juice, while abundant in quantity, is lacking in both acid and sugar, resulting in a very inferior quality of fruit. This example is typical of the occurrence of frequent and striking bud variations in citrus varieties. It explains the origin of the many diverse strains of the commercial citrus varieties in California. It explains the presence of the many trees of these strains in the citrus orchards. It also shows the necessity for care in the selection of budwood in order to avoid so far as possible the propagation of bud sports. The selection of parent trees and of fruit-bearing budwood in these trees can be most safely done by means of individual tree performance records and intimate tree knowledge.




**SECTIONS OF NAVEL ORANGE TYPES**

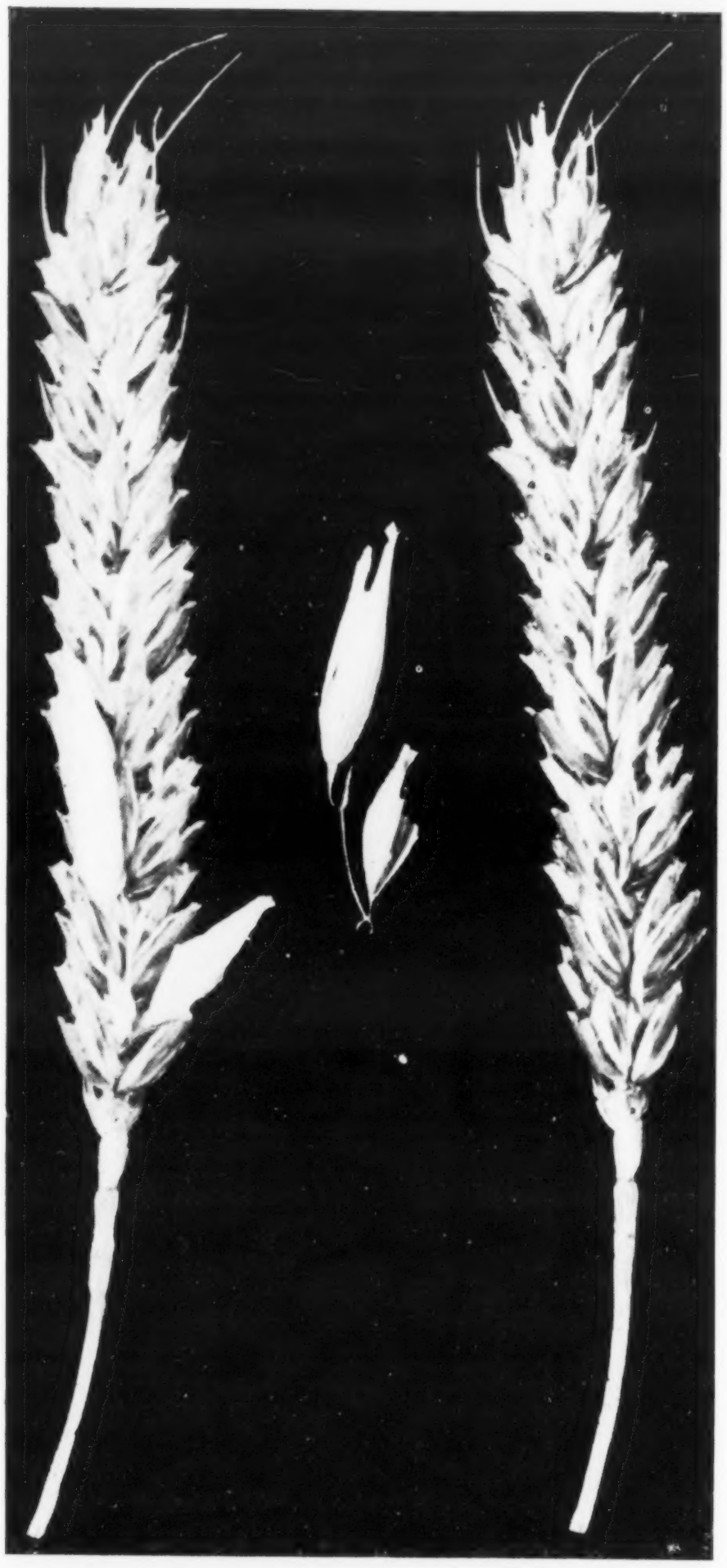
Vertical sections of the oranges shown in Fig. 1. Section 1, Thomson navel orange; section 2, Washington navel orange; sections 3 and 4, corrugated navel oranges. In addition to the difference in rind there are marked differences in the quality of these fruits. The Washington fruit is superior to the others in tenderness of flesh and amount and flavor of juice. (Fig. 17.)




**WASHINGTON AND CORRUGATED NAVEL ORANGES**

A Thomson strain tree of the Washington navel orange variety in the Eureka orchard near Riverside, California, produced the fruits shown in this photograph. Fruit 1, a typical Thomson navel orange; fruit 2, a typical Washington navel orange; fruits 3 and 4, typical Corrugated navel oranges. The Washington and Corrugated strain fruits are borne by individual limbs. This case is typical of the remarkable and frequent bud variability of the navel orange and other citrus varieties. (Fig. 18.)

# NATURE AS A NATURE-FAKER



HOW A FREAK OCCURS

In producing the freak illustrated herewith nature assumed the same rôle as the student of entomology who sought to fool his professor by making up an insect from the parts of several unrelated insects. The specimen was a chance find by a man in northeast Texas. He was honest in his belief that the wheat head had produced two kernels of oats.

The specimen was perfect; the oat pedicels came from the base of the central kernel of one of the lower spikelets of the wheat head, the attachment being completely hidden by the stiff outer glumes crowded together at this point. On the left is shown the wheat head with the oat kernels attached and on the right the results of dissection with the aid of moisture. The oat pedicel was wrapped completely and tightly around the base of the central floret of the wheat spikelet. The opportunity for this queer behavior must have been afforded by the fact that an oat plant grew close to the wheat plant and while the pedicel was very young and sensitive the head of wheat and oats were brought together by some ageney, presumably wind. The pedicel behaved as a tendril and upon nearing maturity pulled the oats from the parent oat plant. (Fig. 19.)

E. P. HUMBERT,
*Agricultural Experiment Station,*
*College Station, Texas.*

---

## Food in War Time

FOOD IN WAR TIME, by Graham Lusk, Professor of Physiology, Cornell University Medical College in New York City. Pp. 46. W. B. Saunders Company, Philadelphia.

Dr. Lusk points out admirably well the important fundamentals of food and nutrition and lays down valuable suggestions for a balanced diet of war time foods. This is particularly valuable at the present time, when many are anxious to effect a change of diet in order to comply with rulings of the Food Administration, but find themselves unable to do so satisfactorily. The second chapter deals with calories in common life and presents figures showing calories used per square meter of body surface at different ages and in various occupations. Exhaustive tables are presented showing cost of one thousand calories in various foodstuffs. Eight rules of safety and saving are set forth in the third chapter, which summarize the fundamentals of the discussion, and furnish an easily followed guide toward food habits which will not only follow the rulings of conservation but will also be entirely enjoyable.